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THE CLINICS

OF

JOHN B. MURPHY, M.D.

AT

MERCY HOSPITAL, CHICAGO

Edited by
P. G. Skillern, Jr., M. D.
of Philadelphia

VOLUME V, 1 *1916*

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RICHMOND STEPHENS, M. D.

Volume V THE CLINICS OF JOHN B. MURPHY* Number 1

CONGENITAL CYST OF NECK EXTENDING INTO AXILLA—EXPECTANT TREATMENT

Summary: Clinical history of patient; examination—physical, fluoroscopic, roentgenographic; diagnosis; treatment; comments on congenital and branchial cysts.

CLINICAL HISTORY OF PATIENT

The patient, a little girl two and one-half years of age, was brought to the office on November 10, 1915. She is the only child of healthy parents, whose past history is negative.

When the patient was two weeks old a tumor the size of an adult thumb was noticed beneath the right axilla. This tumor increased in size for one and one-half years until one year ago, when it reached the present size of four inches in diameter.

When the patient was three months old a second tumor appeared on the right side of the neck, just above the clavicle, and increased in size rapidly for a while, but not during the past year. It seems to become larger when the patient cries or coughs. A piece of the tumor was removed and subjected to microscopic examination, and is said to have been fatty tissue, but the real report is not definitely known. The patient has no fever, no cough, nor has she bowel or bladder disturbance. She weighs 23 pounds—a weight which has remained stationary for some time.

Examination by Dr. Murphy.—Above the right clavicle there is a large, soft tumor which is not adherent to the skin (Fig. 1). In the right axilla there is a similar tumor, and there are also several nodules about the size of a hazelnut just beneath the skin. There is no palpable or audible thrill over either tumor. Superficial veins over both tumors are dilated.

Examination of the tumor of the neck with an electric lamp shows no transmission of light. The tumor fills the supraclavicular space, so that the chin almost rests upon it: it presses into the mediastinum and the clavicle is bowed forward. From the neck the tumor extends beneath the clavicle into the axilla, where it is associated with a lipoma.

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*This number of the Clinics was edited by Dr. P. G. Skillern, Jr., of Philadelphia.

On percussing the chest superficial flatness but deep resonance are obtained, indicating that the tumor does not fill the chest, but extends into the mediastinum. When the patient lies down the cyst is under much lower tension than when she stands up. The axillary portion of the cyst is continuous with the supraclavicular portion, as bimanual palpation suggests an interchange of fluid from one position to the other.

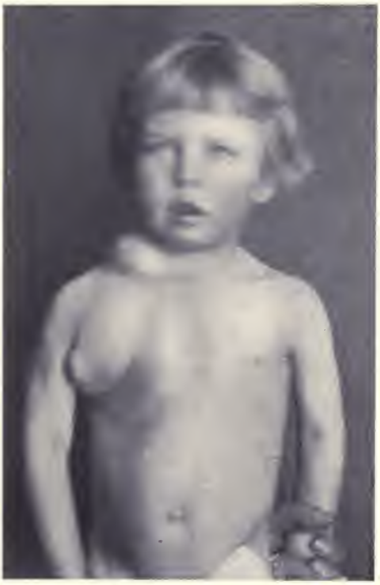

Fig. 1.—Bimanual palpation suggests interchange of fluid between cervical and axillary portions of cyst.

With the fluoroscope the transparency below the lumen is clearly visible. The skiagram confirms the extension of the tumor into the chest (Fig. 2), and there appears to be grumous material in the fluid, which casts a shadow almost as dense as that of the heart.

The tumor is a classic condition—a congenital cyst of the neck extending into the axilla and mediastinum; the latter mode of extension is rare. It contains blood or grumous material. Operation offers no hope of cure, and we shall adopt a "watchful waiting" policy because it is a well-recognized fact that these congenital cysts of the neck often disappear without any treatment, surgical or otherwise.

The cysts are of two types—the lymphangiomatous and the hemangiomatous. Cysts of the latter type occasionally communicate with the veins in the neck or mediastinum: they often fill the intermuscular spaces so as to resemble a dissection of the neck. When small, they should be removed by careful dissection, retaining tension on the sac while the work is being executed; when large, dissection is impracticable (Fig. 3). Partial removal of the cyst should not be attempted, as it sometimes stimulates excessive secretion in the remaining portion, causing sinus-formation: the sinus and the remainder of the sac then become infected, and the patient's life is thereby endangered.

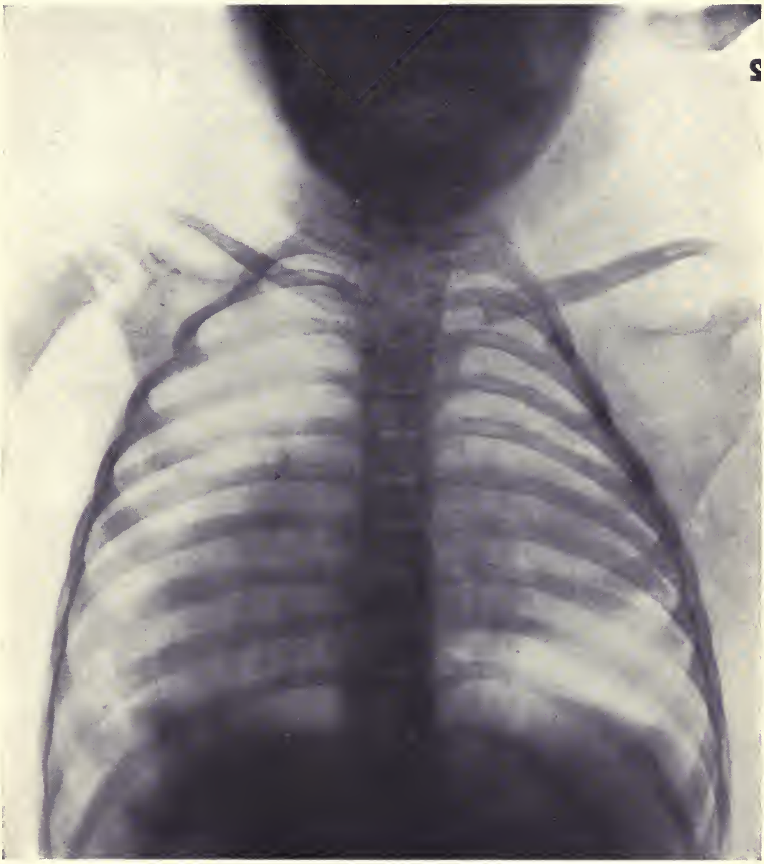

Fig. 2.—Skiagram confirms physical signs of extension of cyst into chest.

The cysts should never be injected with irritating fluids: infection of the sac by injections, explorations, or otherwise is

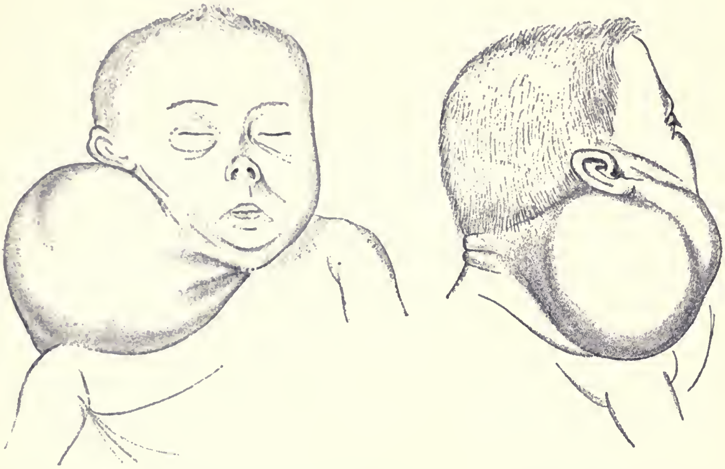

Fig. 3.—Congenital hygroma of neck (Hochenegg). (From Keen's "Surgery.") Owing to large size of tumor, removal by dissection is impracticable.

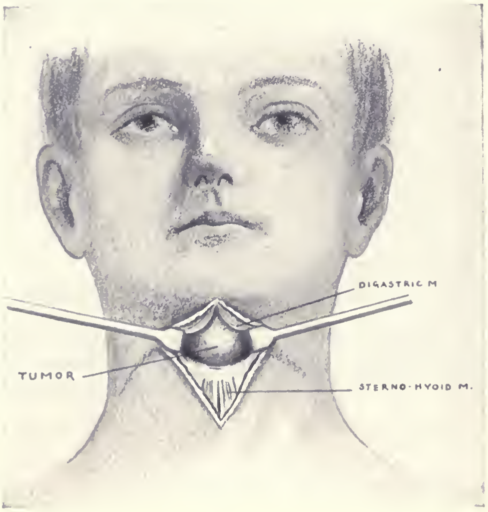

Fig. 4.—Operation for thyroglossal duct cyst (J. B. Murphy in Keen's "Surgery").

always a serious complication, for then the patients suffer from high fever, frequently recurring chills, delirium, and all the symptoms of septic absorption. The chills and fever are of a type peculiar to intravenous sepsis, such as pylephlebitis, suppurating angiomata, etc. *X*-ray treatments should be advised, as we know their effect upon aplasic tissues.

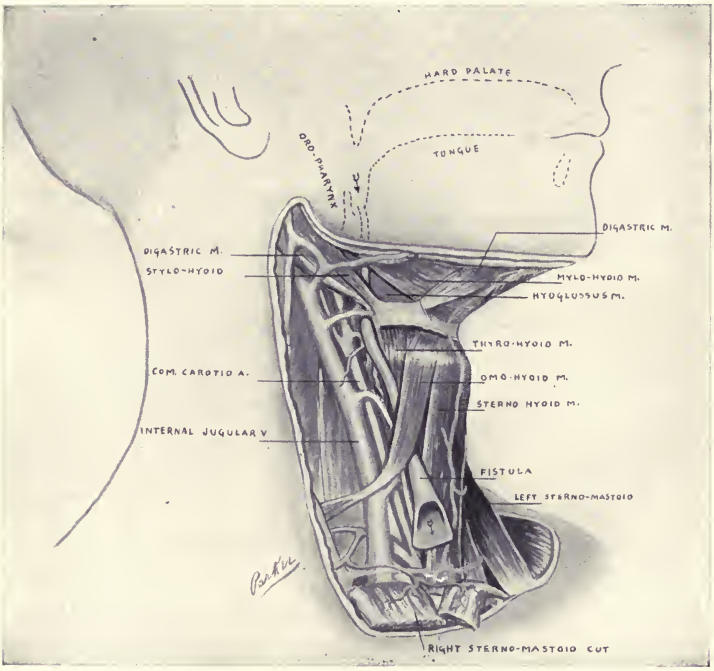

Fig. 5.—Dissection of branchial fistula to show anatomic relations (E. Wyllys Andrews in Keen's "Surgery").

These cysts must not be confounded with the branchial or the thyroglossal duct cysts in their etiology, location, or in the type of tissue-dissection which they produce (Figs. 4 and 5).

[Of interest in this connection is the case of "Congenital Sinus of Neck" which was published in vol. iv, December, 1915, pp. 1059–1066, together with a table of tumors of the neck.]

ADENOCARCINOMA OF BREAST—REMOVAL OF BREAST WITH PECTORAL FASCIA.—TALK ON CERTAIN ASPECTS OF THE METASTASES OF CANCER

Summary: Clinical history of patient; examination; comments—course of Paget's disease of nipple; three causes of a bloody discharge from nipple; Paget's disease eventually malignant in ratio of 100 per cent.; operation—importance of avoiding hand-contacting of tissues; removal of breast and pectoral fascia; recapitulation; postoperative comments—examination of operative specimen; prognosis favorable because tumor was a scirrhus and was removed early; citation of most recent ideas concerning Paget's disease. Talk on metastases of cancer.

CLINICAL HISTORY OF PATIENT

The patient, a female seventy-one years of age, married forty-one years, nullipara, was admitted to hospital August 31, 1915. The family and past histories are negative.

Two months previous to admission, in June, 1915, the patient noticed for the first time beginning soreness, redness, and swelling around the nipple of the left breast. An ointment was applied to the inflamed area, and the sore place cleared up. On July 30, 1915, the patient was first seen by her physician, who advised that an operation be performed upon the breast.

Examination by Dr. Murphy (August 24, 1915).—The right nipple is normal. On the left side there is pronounced retraction of the nipple. A drop of blood appears occasionally on the surface of the left nipple: the center of the nipple is inverted, but not eroded. There is no extensive induration of the breast, but moderate thickening of the tissue at the base of the nipple: no nodules are palpated. There is no enlargement of the axillary lymph-nodes on palpation, nor any enlargement or thickening of the skin or subcutaneous tissue between the breast and the axilla. Equalized compression of the breast as a whole does not force bloody discharge from the nipple, but localized pressure upon the lower quadrant of the breast causes oozing out of slightly blood-stained fluid from the nipple. The pulse is slow, full, and regular. This case presents the earliest manifestation of Paget's disease and requires an operation.

COMMENTS

Dr. Murphy (September 1,1915): That history is very brief. First, a little erosion appeared on the nipple—the little erosion which is the initial symptom of Paget's disease. The usual course of this disease is that the erosion gets better and then becomes worse. These cases run along for two, three, four, five, six, and seven years,—and even so long as ten years,—the lesion as it recurs becoming a little larger each time until eventually the lesion involves all the nipple and all the areolar tissue over an area the size of a quarter of a dollar.

A bloody discharge from the nipple occurs in three conditions. It occurs first—and most commonly—in carcinoma beginning in the lactiferous ducts; secondly, in a small papilloma situated likewise within the lactiferous ducts; thirdly, in small cysts which communicate with the lactiferous ducts, and which contain in their interior a small papilloma.

In the case of carcinoma of the lactiferous ducts, or beginning Paget's disease, the quantity of discharge is very much smaller,—not often staining an area of dressing larger than a grain of wheat,—but the discharge recurs more frequently and has an intermission of from ten days to two weeks in which there is no discharge.

A papilloma in the ducts starts bleeding, then stops for a few days, and finally starts to bleed again and bleeds for many days, like an ordinary papilloma situated elsewhere in the body.

When a cyst communicating with the lactiferous ducts is present, the span between the periods of discharge is greater, and the quantity of discharge—if any discharge be present—is also greater.

What is the final outcome in the cases of Paget's disease? The final outcome is carcinomatous degeneration: *Paget's disease eventuates in carcinoma in the proportion of 100 per cent.* Think of it! Such a lesion is, therefore, essentially and clinically a potential carcinoma the first day it is seen by the physician. In the early stage Paget's disease is essentially innocent, as is epithelioma that involves the lactiferous ducts, and as are papillomata that occur both in cysts and in the ducts, but eventually they all become malignant unless operated upon.

Now at last we are slowly learning—and I must say that, as a profession, we are *very slowly learning*—that the first erosion of the nipple or the first induration at the base of the nipple in non-lactating patients is suggestive of the first manifestation of Paget's disease, and should be operated upon immediately. The most wicked cases of carcinoma of the breast that I have seen here have developed upon the basis of Paget's disease. A recent case in which there were palpated nodules of multiple carcinoma throughout the breast was, in my opinion, Paget's disease in the beginning. But knowing the story and knowing the fact that eventually cases of Paget's disease all undergo carcinomatous degeneration, the moment one sees such a case one's immediate obligation is to remove the breast. We do not expect to remove the axillary lymph-nodes in this patient's case. This breast amputation is merely a minor operation insofar as her life is concerned.

I wish to congratulate the physician who sent in the patient for recognizing the first red flag of danger,—that little drop of blood that came from the nipple,—and for taking an action that is probably going to save the patient's life. It is now only a few weeks since he saw the patient for the first time. The patient, too, was extremely sensible about operation. The moment we explained to her the dangers associated with non-operative treatment, she could not get to hospital quickly enough: she did not want to tinker with nitric acid, or glacial acetic acid, nor did she want to have a caustic paste tried. I feel that the responsibility for educating the people in regard to the dangers of dilly-dallying with malignant disease rests with us, and that we have not disseminated our great and important knowledge concerning malignant disease through the lay press as we should have disseminated it, so that knowledge of cancer is now imparted to the people chiefly through the household almanacs.

There is another salient symptom in this case—the marked retraction of the nipple. In the intern's history, the statement is made that there is a tumor in the breast: there is nothing that one could call a well-defined tumor—there is merely the slightest suggestion of induration near the nipple. When I examined the breast a week ago there was a bloody stain on the dressing: today the stain is yellow only, and not tinged with blood.

OPERATION

Since we are not going to expose the axilla, we shall not have to include it in the plan of the incision, so that there will be ample skin to cover the operative field. I want, if possible, to keep from hand-contacting of the tissues. Hand-contacting forms the greatest source of danger of introducing sepsis into the wound. I wish to remove the deep fascia covering the pectoralis major muscle, but I am not going to excise the pectoralis major itself. [Oval incision made around breast.] You see how wide of the mammary tissue I make the incision, notwithstanding the small size of the tumor itself. [Dissects skin-flap up and frees breast from underlying tissues.] See! There is the fascia covering the pectoralis major muscle. [Dissects fascia with overlying breast from fibers of pectoralis major until that muscle is clearly exposed; removes breast, together with fascia, and closes wound without drainage.]

RECAPITULATION

Let the record show that we removed the breast together with, and still attached to, the deep fascia covering the pectoralis major muscle; that we did not remove this muscle, nor expose the axilla; that we accomplished the work all without hand-contacting; and finally that we were able to control the bleeding before closing, and closed the wound without drainage.

POSTOPERATIVE COMMENTS

Upon examining the specimen grossly we feel that it is a carcinoma: it is not quite so large as a lima-bean, and is scirrhous in type. What does *scirrhous* mean? Scirrhous means that there is a large preponderance of connective tissue around the clusters of malignant cells—that the malignant cells are thereby coffer-dammed and held imprisoned from metastasizing by the connective-tissue trabeculæ for months, even years. The prognosis in this case is favorable because of the early stage and scirrhous nature of the cancer, and we feel that we should again congratulate the physician for his diagnostic acumen in recognizing that first little red flag,—the blood-tinged staining,—that, if unheeded, means ultimate disaster to the patient. This is a most satisfactory case of cancer to deal with, because in the average case that comes to me the cancer is almost as large as my fist. In this case there was no palpable mass at all in the breast, but there appeared to be a small, ill-defined area of induration about the nipple-base.

[The pathologist reported that the tumor was an adenocarcinoma.] There was healing *per primam.*

* * * * * * * *

We have come back to the surgical principle that prevailed when I began to study medicine—in the days when Baxter and Bevan's father were practising surgery. "*Excise—and excise early—every tumor of the breast, regardless of how small it is or how innocent it seems.*" Remember, the ultimate mortality of cancer of the breast is just as bad today as it was thirty-five years ago, if not worse than it was then.

I cannot end the discussion of this case to better advantage than by quoting the conclusions reached by Jopson and Speese in their paper entitled, "Paget's Disease of the Nipple and Allied Conditions," which was read before the meeting of the American Surgical Association at Rochester, Minn., June 10, 1915.

"1. Paget's disease of the nipple is a primary affection beginning in the cells of the rete Malpighii, potentially malignant, although lacking the ordinary microscopic characteristics of malignant disease.

"2. It is identical with the disease known under the name of Paget occurring in other regions.

"3. It is commonly, although not invariably, followed by glandular carcinoma in the underlying breast-tissue.

"4. It is precancerous in the sense that it induces epithelial changes in the superficial milk-ducts and acini, which are followed by carcinoma. Occasionally, although rarely, it is followed by squamous-cell carcinoma of the nipple.

"5. The disease is characterized by edema and vacuolization of the prickle-cells, thickening of the rete, and active mitosis, also by an inflammatory reaction in the corium and a secondary hyperplasia in the milk-ducts.

"6. It is sharply differentiated from true eczema and scirrhous carcinoma ulcerating at the nipple, and should not be confused with superficial metastases of diffuse cancer situated near the skin.

"7. The resulting tumors of the breast and the regional metastases resemble the type of breast-cancer usually encountered. When the tumor originates in the skin, it infiltrates and metastasizes in the form of squamous carcinoma.

"8. The common association of cancer in the breast with Paget's disease demands, as the treatment for Paget's disease, the radical operation which is practised in breast cancers in general."

TALK ON CERTAIN ASPECTS OF THE METASTASES OF CANCER

The escape of the malignant cells, and their transmission to remote parts, occur, first, through the lymph-vessels that lead from the zone in which the cancer is situated. That is the general law. Applying this law to the breast, the lymph-vessels run from the breast first into the axilla; secondly, to the second intercostal space; thirdly, through the sixth intercostal space, in company with the blood-vessels; fourthly, downward to the navel, thence along the round ligament to the liver. Until Handley revealed the true status of this last path, we did not really believe that transmission of carcinomatous cells occurred through this channel, which may rightfully and justly be termed Handley's channel.

We believe that, so far as the transmission of carcinomatous cells in general is concerned, Handley's conclusions are erroneous, and we base this belief not on the clinical course alone, but also on the necropsy findings of carcinoma. In support of our belief we have analyzed the results of necropsies upon a large number of cases (10,315) of carcinoma—performed in the pathologic institutes of the world—for the purpose of determining what the extent of metastases was when death claimed the patient. In the first instance, we found that the metastases involved the lymph-nodes prior to other structures. Secondly,—and this finding surprised us,—it was revealed that in all carcinomata *below* the level of the clavicle—clear down to the toe—the most common seat of metastases, after the lymph-nodes, is the liver. Thirdly, of the cases of cancer occurring *above* the level of the clavicle (including those involving the thyroid gland), the most common seats of metastasis, after the lymph-nodes, are the lung and the pleura: at the necropsy-table it was often difficult to determine which began first—the lesion in the lung or the lesion in the pleura.

Another statistical gleaning that surprised us very much was that 19.7 per cent. of all carcinomata had no demonstrable metastases when the cases came to the necropsy-table. This means that, in 19.7 per cent. of the cases, the disease was still a localized lesion at the time of the patient's death. *The* great surprise to us was that there was no metastasis through the veins, through the lymph-spaces, nor through the arteries. The practical application of this fact is that, if we can remove the local lesion in its entirety, cure will result in 19.7 per cent. of cases of carcinoma, as far as metastasis is concerned.

The site which is the source of the greatest percentage of metastases is the breast, since the breast was free from demonstrable metastases in but 3 per cent. of the cases. The clinical significance of this last fact is that the breast, which harbors cancer, should be removed at the earliest possible moment, if for no other reason than as a prophylactic measure against metastases. Cancer in the breast is, however, fortunately in a site where the tumor can be recognized early, and if we should educate the public—and we *can* educate them through the lay press—and their physicians in the early recognition of these lesions, and in the importance of taking some positive action toward cure while the lesion is still in the initial stage, then we may hope to get better results and obtain more cures. I must say frankly that the blame for the delay by no means rests entirely with the people. It is surprising what a large percentage of these cases comes here, weeks, months—and occasionally even years—after having consulted a physician who did not advise radical procedure. Such is the tragedy of procrastination, rather than of ignorance.

The early and rapid malignancy of carcinoma depends upon the richness of the lymphatic supply of the zone in which it originated. In rich lymphatic zones metastases occur early, and in a certain order. In sparsely supplied lymphatic zones, if metastases occur at all, they occur late in the course of the disease.

Now, then, let us see where we have most commonly in cancer early, frequent, and fatal metastases, and where slow, late, or no metastases at all. In illustration of the former group, let us take the breast first. The breast is the most frequent source of early and fatal metastases. In other words, a woman of forty or forty-five years of age who comes to you with cancer of the breast is an example of the old proposition of "*fair*, *fat*, *forty* and—(with just another "*F*" on it)—*fatal!*" Such patients practically all die. I do not think I have a single fat patient under forty years of age who has permanently survived an operation for carcinoma of the breast, or in whom an ultimate cure has resulted. The site which, after the breast, is the next most frequent source of early and fatal metastases is the cervix of the uterus.

In illustration of the second group, a site involved by cancer from which metastases are the least liable to occur and, when occurring, develop slowly or appear late, is the fundus of the uterus, as well as cancer in the fundus of all organs, as the fundus of the stomach, the fundus of the cecum (*caput coli*), the fundus of the gall-bladder, and the fundus of the urinary bladder.

In the alimentary tract carcinoma of the sigmoid, at necropsy, furnishes the least percentage of metastases of carcinomata situated anywhere in the body—44 per cent. are free from all types of metastases, even the lymph-nodes. There is an additional reason why a patient with scirrhous carcinoma of the sigmoid should come to the necropsy-table without metastases: it is the tendency of scirrhous carcinoma to cause early stenosis with constriction of the intestine, then occlusion and obstruction, so that the patient dies, not from the intoxication of the carcinoma, but from the effects of the intestinal obstruction produced by the carcinoma. Again, the sigmoid has few lymphatics. The reason why, of the internal carcinomata,—except that of the fundus of the uterus,—carcinoma of the sigmoid yields the greatest percentage of permanent cures, when the patient survives the operation, is the scarcity of lymphatic supply, so that the hope for ultimate postoperative recovery from carcinoma in the digestive tube is greatest in carcinoma of the sigmoid if operated upon by a suitable technic. Unfortunately, in many of these cases of carcinoma of the sigmoid the patient who comes for treatment is of the *sixty-year-old type*, with arterial changes, and often with an enormous amount of fat in the mesentery, so that, so far as the operation *per se* is concerned, such a patient is a very poor operative risk right from the beginning; but when a patient with carcinoma of the sigmoid survives the operation, his chances for permanent cure are very good. Therefore, in all these cases we should arrive at a correct diagnosis before the patient shows manifestations of obstruction, because, after the manifestations of obstruction have been present for a long time, lethal intoxication supervenes. In these cases, if the patient is in a state of active obstruction, it is not wise to perform an extensive operation other than that of colostomy, and the colostomy should be performed by the method that affords the greatest exposure with the minimum of technical manipulations. Colostomy, which is performed through an incision just above the anterior superior iliac spine and a little to the outer side (lumbar colostomy), fulfils these conditions, and this site is a good position for the opening because the patient can dress the wound and care for it himself without difficulty (*vide infra*, pp. 31 *et seq.*).

The carcinomata that give the third largest percentage of permanent cures are those that involve the caput coli, excluding those that involve the ileocecal valve. The ileocecal valve has a rich lymphatic supply, and therefore carcinoma of the ileocecal valve yields early metastases and causes a high percentage of fatalities. The caput coli itself has a sparse lymphatic supply, but then carcinoma does not frequently involve the fundus of an organ, as the caput coli, the fundus of the stomach, the fundus of the gall-bladder, or the fundus of the urinary bladder. Carcinoma involves by preference those portions of the digestive tube that are subject to the greatest degree of irritation from repeated expansions and contractions, and to an almost continual retention of the contents of the alimentary canal, as the hepatic and splenic flexures of the large intestine and the upper portion of the rectum, where the retention is probably greater than at any other portion of the alimentary tract.

[The following is the bibliography of the subject of carcinoma of the breast from previous numbers of the Clinics: "Carcinoma of Breast," February, 1912, pp. 1–16: "Carcinoma of Breast—Talk by Professor Bastianelli," December, 1912, pp. 779–793; "Carcinoma of Male Breast," June, 1914, pp. 569–574: "Carcinoma of Breast—Talk by Dr. Rodman," April, 1915, pp. 247–275; "Cylindric-cell Carcinoma of Breast," August, 1913, pp. 625–629: "Paget's Cancer," August, 1914, pp. 769–774 (with colored plate); February, 1913, pp. 99–106; "Malignant Papillomatous Cyst of Breast," August, 1914, pp. 711–718: "Differential Diagnosis Between Benign and Malignant Breast Tumors Before and at Operation. Varieties. Atypical Forms. Clinical Course. Relation of Trauma to Carcinoma and Sarcoma. Scirrhus," June, 1914, pp. 413–427 (illustrations of operative steps); "Radical Operation for Carcinoma of the Breast, With Description of Dr. Murphy's Special Technic," February, 1914, pp. 179–190 (Table of Tumors of Breast); "Carcinoma of Femur, Metastatic From Breast," June, 1914, pp. 557–568 (resection of femur—bone-transplant).]

I. ULCER OF DUODENUM — DUODENORRHAPHY — POSTERIOR GASTROJEJUNOSTOMY BY BUTTON METHOD. II. RETROVERSION OF UTERUS—ROUND LIGAMENT SUSPENSION

Summary: Clinical history of patient; examination; comments—question of a preceding pelvic infection; isolation of an upper abdominal from the uterine lesion; operation—importance of large incision in exploring abdomen; exclusion of skin-edges from operative field; exploration of upper abdominal zone—area of stippling on duodenum found, indicating site of ulcer; appendix found normal; exploration of pelvic zone—retrodisplacement of uterus found and corrected by using round ligaments as supports; function of round ligaments; actual supports of uterus; objections to ventrofixation; comments on gastric *vs.* duodenal ulcer with statistics; operation—posterior gastrojejunostomy by "button" method; jejunal ulcer sequential to gastrojejunostomy; occlusion of pylorus unnecessary; recapitulation; postoperative comments—advantages of the button method.

CLINICAL HISTORY OF PATIENT

The patient, a matron thirty-six years of age, was admitted to Mercy Hospital September 23, 1915. The family history is negative. When twelve years of age the patient suffered an attack of typhoid fever, and two years later one of acute rheumatic fever, with involvement of the knees, ankles, and joints of the feet.

The menses began at the age of thirteen, have always been regular, of three days' duration, and painless until the birth of the last child, eight years ago, since which time the amount has slightly increased. During the last two years the periods have lasted from six to seven days, and the pain and headaches have been very severe. During the last three months the patient has been compelled to take to bed at menstrual periods on account of severe pain in the lower abdomen and unendurable headaches.

At present the patient feels sluggish, weak, and unable to work. She has lost three or four pounds in the last year: there is no cough. There is occasionally a dull ache in the epigastrium during meals, and at times immediately after meals, but the pain bears no relation to the variety of food ingested. During the past month swelling and stiffness have appeared in the small joints of her hands.

Examination by Dr. Murphy (September 9, 1915).—The right kidney is enlarged and comes forward, at first giving the impression of being a gall-bladder: it is very sensitive to pressure. The uterus is fixed to the left side of the pelvis and retroverted to the third degree: the condition of the tubes and ovaries cannot be determined. There is nothing palpable in the right vaginal fornix. A sensation of resistance is imparted deep down in Douglas's pouch. There is no thickening of the right ureter.

COMMENTS

Dr. Murphy (September 25, 1915): Were any of the parturitions followed by puerperal infection? According to the patient's statement, no such infection arose. On account of the extreme degree of retrodisplacement of the uterus I could not palpate the ovaries or tubes. If there was no Neisserian or puerperal infection, there should be no pus-tubes, and the uterus should not be bound down by organic adhesions.

The pain in the right side, which is independent of the uterine displacement, is indicative of trouble in the upper abdomen. We all know that in the presence of third degree retrodisplacement of the uterus the functioning of other abdominal organs may be entirely disarranged. I made a memorandum that calls for exploratory examination of the gall-bladder and appendix; for in the history obtained from the patient at the office there is nothing to indicate what organ, aside from the uterus, is the seat of disease. That abdominal condition must be entirely cleared up before we proceed with the operation for retroversion.

What is the relative value of the factors which constitute a differential diagnosis? The history itself contains on the average about 80 per cent. of the information, while the physical findings, laboratory data, etc., make up the remaining 20 per cent.: therefore, we lay great stress upon the patient's history.

Some of you will recall a recent case in commenting upon which we stated that the gall-bladder should be examined at operation, because of its very marked sensitiveness to the perpendicular finger-percussion test. While the history revealed digestive disturbances coming on from three to five hours after each meal, yet there was no history of gall-stone colic. In that patient we found hydrops of the gall-bladder, with a calculus impacted in its neck.

OPERATION

[Long vertical incision made through right rectus muscle.] I am making a large incision so that I may inspect the entire right upper abdominal region. If one is going to make a thorough abdominal exploration, let him make it—not pretend to make it, but *make it:* you cannot explore the abdomen satisfactorily through a small incision. Now I am clipping towels to the edges of the skin to prevent contamination of the operative field from that source: I am becoming more and more fearful of contamination from contacting,—particularly hand- and skin-contacting,—and I am as much afraid of the irritation from the iodin as of the germs harbored by the skin. We learned these minutiæ of asepsis from our bone and joint work, in which one must be much more cautious about non-sterile contacting than in abdominal work, because bone or joint tissue offers no such stout resistance to infection as the peritoneum,—the greatest infection-resisting tissue in the body,—but when this peritoneal resistance goes wrong, it goes wickedly wrong and kills your patient. In the dog it is almost impossible to infect the peritoneum, but the opposite obtains when you come to perform arterial or bone work upon dogs, for these structures offer little or no resistance.

There is the transverse colon. . . . Now I have the gall-bladder between my fingers and am slowly compressing it: it does not compress rapidly. . . . I am unable to palpate any calculi.

Let the record show that there are no calculi in the gall-bladder.

Passing my finger through the foramen of Winslow, I encounter in the free edge of the lesser omentum, on the left, the hepatic artery; on the right, the common bile-duct; and below, the head of the pancreas. The lymph-nodes bordering upon the head of the pancreas are enlarged, but the pancreas itself is neither infiltrated nor indurated.

There is the stomach, bulging into the field: here is the pyloric zone. Just beyond the pylorus we see on the duodenum an area of stippling to which attention has been called by Scudder, of Boston: it is just on the duodenal side of the pylorus, and, together with a white line and a slight area of depression, indicates the site of a duodenal ulcer.

Let the record show that there is no stenosis of the pylorus; that an ulcer was found on the duodenal side of the pylorus, whose site was indicated by an area of stippling.

Now let us go down lower, to examine the appendix. With such an atypical history it is important to explore the abdomen in a systematic manner. . . . The appendix is perfectly normal: there is no Lane kink. The ileum has an unusually long mesentery, which accounts for the large number of coils of small intestine that are lodged in the pelvis.

Reaching the pelvis, the first structure I encounter is the neck of the uterus projecting through the anterior wall of the vagina; and behind the broad ligament there are web-like adhesions binding the uterus to the rectum and posterior pelvic peritoneum. We shall first correct the retrodisplacement of the uterus and then turn our attention to the duodenal ulcer.

[Withdraws loops of intestine from pelvis and drags uterus forward.] . . . . Now I shall free these inflammatory, web-like adhesions, so as to be able to restore the uterus to its normal position of anteversion. [Dissevers adhesions.] Now the uterus can be brought forward clear to the anterior abdominal wall. This case is unsuitable for the Alexander-Adams operation as ordinarily performed because the organic adhesions would effectually prevent the uterus being brought forward by traction upon the round ligaments in the inguinal canals.

There are the round ligaments, passing from the internal abdominal rings through the broad ligaments to the uterus, to which they are attached anteriorly just below the cornua. By bringing the round ligaments over the dome to a position just posterior to the uterus and attaching them along the intertubal line, the uterus is held forward (Fig. 6), and neither the ability to conceive nor to carry a child will be interfered with.

While we have been performing this operation for many years, yet we do not claim to have originated it, and that is, after all, an inconsequential matter. It is the shortening of the round ligaments, using a fold of peritoneum as an aid, that supports the uterus so well. The Webster operation is performed by splicing the round ligaments and then bringing them around posteriorly; in some cases this procedure successfully fulfils all the

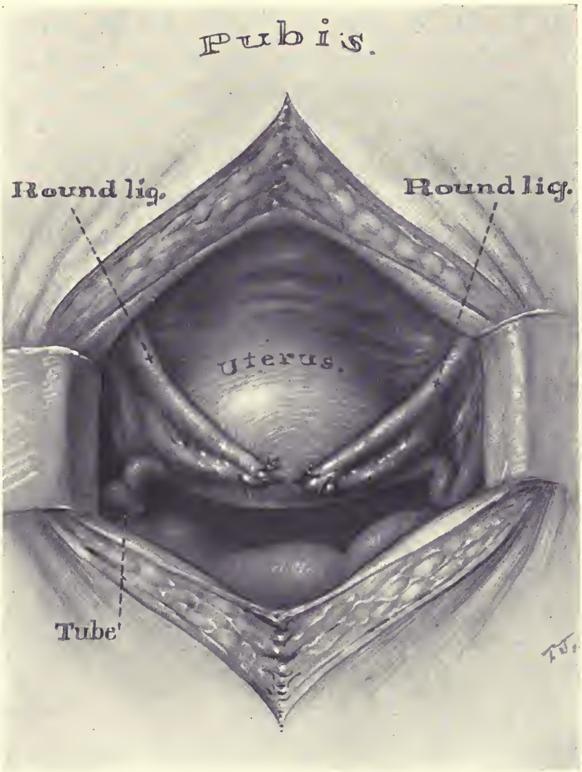

Fig. 6.—Round ligaments angulated and anchored to posterior wall of uterus near dome and opposite intertubal line. (Sketch made at operating table.)

requirements, but in this case it would not afford the maximum mechanical support, because the ligaments are attached to the uterus too far below the summit of the dome, and organic adhesions existed previous to operation. In the method which we employ, on the contrary, the ligaments are attached at the highest point of the dome—hence the great degree of mechanical support.

The round ligaments do not support the weight of the uterus at all: their function is merely a balancing one—they act as guy ropes. The structures which do support the weight of the uterus are those attached to the organ at the cervicocorporal junction, and include the strong uterosacral ligaments.

Formerly we performed the ventrofixation operation after the plan of Kelly, but found that the results were not good. As is shown in his illustrations of this operation, the site of adherence of the uterus to the peritoneum of the anterior abdominal wall eventually becomes spun out into a long, fibrous cord, which produces serious disturbances, so that when the patient coughs or sneezes, jumps from the street-car or from her carriage, she must grasp her abdominal wall, because of the pain resulting from the traction in such activities. This is in complete accord with the mechanical condition, which is established by the operation. Every time the patient takes a full breath the pelvic floor descends, and at the same time the lower anterior abdominal wall goes forward, so that, with the lungs filled, there are two diverging lines of traction upon the fixed uterus—one in the downward direction and the other forward. [Closes lower portion of abdominal incision by a figure-of-8 suture in the usual manner, with ectropion of the cut edges of the peritoneum.]

This patient presents no history of duodenal ulcer: she does not state that distress comes on two and one-half or three hours after meals, but that the gastric distress occurs promptly after eating, which suggests gastric ulcer. We found the ulcer on the duodenal side of the pylorus: it does not matter whether the ulcer is on the gastric or duodenal side, the same operation of gastrojejunal anastomosis is indicated.

Our ulcer statistics show that pain is the commonest symptom, and was present in 94 per cent. of the cases; food-distress, in 62 per cent.; emesis, in 67 per cent.; hematemesis, in only 22 per cent.; blood in the stools, in 51 per cent.; while occult blood was present in 81 per cent.—so that, next to pain, occult blood is the most important finding. In connection with pain, eructation of gas is very common: it affords relief from pain for some, but not for others.

In this patient abdominal pain is a salient symptom. There is absence of nausea, of vomiting, of hematemesis, of occult blood in the stools, and of eructation of gas. The symptoms are not at all influenced by food-intake: there is neither food-disturbance nor food-relief. In the diagnosis of duodenal ulcer these details are very important. The indications for exploration of the upper abdominal organs in this case rest solely upon the loss of weight and the distress after eating. The finding of the ulcer shows the wisdom of searching for a definite cause for symptoms—be they never so few—instead of attributing them wholly to the retroversion of the uterus, notwithstanding that the retroversion is of the third degree. In a recent case of ours the symptoms all suggested upper abdominal disease, but exploration revealed no lesion in the upper abdomen—only a chronically inflamed appendix that kept draining into the caput coli: all the upper abdominal symptoms, therefore, were reflex.

Operation.—[Brings ulcer-bearing area into operative field.] There again you see the ulcer, just beyond the pylorus, at the site corresponding to the area of stippling and the slight depression. We shall perform posterior gastrojejunostomy, which relieves the patient by diverting chyme from reaching the ulcer-bearing area. I shall bring the stomach-wall out from the lesser peritoneal cavity through a rent in the transverse mesocolon, and then at once close this opening into the lesser peritoneal cavity by tacking the cut edges of the transverse mesocolon to the stomach behind the intended site of anastomosis, so as to exclude this portion of the posterior wall of the stomach from the lesser peritoneal cavity, and to prevent internal hernia through an unsutured mesocolic rent. Sometimes there are so many blood-vessels in the mesocolon that one cannot tack it for fear of puncturing a vessel during the passage of the needle: in such a contingency the alternative of suturing is to ligate the mesocolic edges and thus secure them to the stomach.

The next step is to bring up the first portion of the jejunum. Note the guide to this portion of gut—the ligament of Treitz, leading from the diaphragm to the summit of the duodenojejunal flexure: not infrequently an ulcer occurs at this site.

In performing the button operation we insert the posterior row of stitches just as when performing gastrojejunostomy by suture alone. We are using sutures of Pagenstecher celluloid linen thread, the capillarity of which has been destroyed through the process of celluloid infiltration. [Adjusts a portion of the jejunum close to the flexure in a clamp, and a portion of the posterior wall of the stomach in another clamp: approximates clamps.] . . . We are now inserting the posterior line of seromuscular stitching, and a half inch on either side of this line and parallel with it we next pucker the wall of each viscus upon a straight needle, and repeat the same procedure a quarter inch beyond each needle. . . . We are now incising the wall of each viscus between the needles, and the looped thread borne by them is made taut upon each portion of an oblong button—the male or cylinder portion of the button being placed in the gastric ostium, and the female or cup portion in the jejunal ostium. . . . Each portion of the button is now fixed in a Hartmann clamp, and the two portions are approximated and pushed home. . . . As the halves of the button are joined together we loosen these clamps and finally remove them. [Puts on a fresh pair of gloves.] Formerly we inserted interrupted stitches around the margin of the button, but now we use a continuous suture. A couple of tacking stitches are finally inserted wide of the site of approximation, to prevent kinking of the bowel. . . . Now we return the anastomosed organs to the abdominal cavity.

Cases are reported in the literature in which a peptic ulcer of the jejunum occurred after this as well as other methods of gastrojejunostomy, but such an ulcer is not caused by the suture, because the latter is entirely out of the field.

The next step is to bury the duodenal ulcer by infolding it, so as to lessen the liability of its perforating. For a while there was a great deal of discussion as to whether the pylorus should be occluded: for our part, we have retired from the discussion and accepted the fact that it is an unnecessary procedure for attaining a good result, and I think that most operators have abandoned occluding the pylorus. [Closes abdominal incision with figure-of-8 suture.]

About two weeks ago we met with a very interesting case which presented symptoms and signs of intestinal obstruction and hematemesis. The question arose whether the hematemesis and vomiting were sequences of the lesion that caused the hematemesis, or of intestinal obstruction. From the history we concluded that there were both gastric ulcer and intestinal obstruction, and performed immediate laparotomy: we encountered, for the first time in our experience, volvulus of the upper portion of the jejunum (*vide infra*, p. 27). There was also a gastric ulcer, which was the cause of acute gastric hemorrhage.

RECAPITULATION

Let the record show that a duodenal ulcer was found just beyond the pylorus; that there was an area of stippling over the ulcer, and a white line with great infiltration, and on palpation, a cavity; and that we performed posterior gastrojejunostomy with a button according to the usual technic, the jejunal ostium being about three inches beyond the flexure.

Let the record show that before closing the wound the operator inspected the field for instruments and sponges to see that none remained, and that Sister Laurian reported the sponges counted and correct.

Let the record show further that we carefully examined the rubber tubing on the anastomosis-clamps, to see that all the lengths were removed with the clamps.

Comments.—One of the advantages that gastrojejunostomy with the button has over that by suture alone is the prevention of consecutive hemorrhage, which is responsible for the greatest postoperative mortality in gastrojejunostomy. Owing to its elastic compression the button is an absolute safeguard against postoperative hemorrhage.

Postscript (*December 20, 1915*).—The patient made an uneventful recovery, and a report received from her one week ago stated that she was feeling very well. The button was passed on the eleventh day.

[Previous cases of duodenal ulcer, with various associated pathologic states, have appeared as follows: Vol. i, February, 1912, 101; October, 1912, 653; vol. ii, October, 1913, 825; April, 1913, 215; 243; 249; vol. iii, April, 1914, 261—statistical analysis on pp. 270–271, and illustrations of the button operation on pp. 276–277; vol. iv, June, 1915, 457—talk by Dr. W. J. Mayo on "Unsuccessful Gastro-enterostomy for Ulcer—An Analysis of its Causes—Suggestions for Better Technic." A case of retroversion of uterus appeared in vol. i, October, 1912, 713.]

VOLVULUS OF JEJUNUM — UNTWISTED; GASTRIC ULCER AT PYLORUS — POSTERIOR GASTROJEJUNOSTOMY BY BUTTON METHOD

Summary: Clinical history of patient; comments—examination; operation—attention called to incision; exploration—volvulus found just below duodenojejunal flexure; volvulus untwisted; gastric ulcer felt at pylorus; posterior gastrojejunostomy performed, using button method; recapitulation; postoperative comments—intravenous saline should be given as soon as the indication for it arises: do not wait until patient is cold and clammy.

CLINICAL HISTORY OF PATIENT

The patient, a male forty-two years of age, was admitted to hospital September 14, 1915, as an emergency case. Being a foreigner and unable to speak English, the history had to be obtained through an interpreter, and for this reason is incomplete. He was ill three years previously, at which time he vomited for months, and "everything he ate hurt him."

The patient was taken ill five days previous to admission, on September 9, 1915, with severe pains high in the abdomen, followed by vomiting. The next day a physician advised immediate operation, but to this the patient did not consent. During the five days between the onset of the illness and the time of admission he vomited continually, and no gas was passed from the bowel.

On admission to hospital the leukocyte count was 11,800; pulse, 72; temperature, 99.4° F. The pulse was feeble—in keeping with the pulse of intestinal obstruction. During the two days previous to admission the vomiting increased in severity.

COMMENTS

Dr. Murphy (September 14, 1915): The patient's stomach has just been lavaged, and coffee-ground material with an offensive odor was withdrawn: it resembled blood more than intestinal contents, and suggested such a hemorrhage as arises from a gastric ulcer. The sensitiveness of which the patient complained was in the upper abdomen. There seems to be distention of the stomach and of the adjacent bowel: this high distention speaks against a low obstruction of the bowel. Diagnosis, intestinal obstruction.

OPERATION

I am making the usual incision through the anterior sheath of the right rectus, displacing the rectus muscle inward, and then incising the posterior sheath, transversalis fascia, and peritoneum in the same line as the incision through the anterior sheath. By this method of incising you do not impair the strength of the abdominal wall: this is one of the best abdominal incisions for a case requiring an extensive exposure for exploratory laparotomy.

There appears to be an effusion of blood in the small intestine, which is distended high up: the large intestine is not distended at any point. Lower down in the small intestine there is no distention. The small intestine, just below the duodenojejunal flexure, is twisted upon its mesentery, forming a volvulus without strangulation. I have never seen volvulus of the small intestine occur so high up as this. [Untwists volvulus: circulation of gut returns immediately.] The ileocecal zone, with the appendix, is negative.

Now I shall examine the stomach for ulcer. . . There is a gastric ulcer at the pylorus: it is a very large ulcer, and accounts for the blood in the bowel above the obstruction, as well as the blood removed by gastric lavage before operation. You see the stippling of Scudder that you hear described so often in connection with these gastric ulcers. The question arises, Is the ulcer carcinomatous? I should say not: it is merely a deep, excavating, non-malignant ulcer.

We shall perform posterior gastrojejunostomy for the cure of the ulcer. [Makes vertical rent in transverse mesocolon; draws posterior wall of stomach through rent.] Now I am suturing the cut margins of the transverse mesocolon to the posterior wall of the stomach, so that, after the operation is completed, the under surface of the stomach will be in the greater, instead of in the lesser, peritoneal cavity. You will note that the circulation in the jejunum has been fully restored and justifies the gastrojejunostomy at this point above the site of the volvulus. [Approximates coil of jejunum to stomach.] Next, we return all the intestines into the abdominal cavity, so as to save them from exposure during the progress of the work. . . I am now putting in the posterior line of seromuscular sutures, approximating the stomach to the bowel: this posterior line of stitches gives additional assurance against leakage, and we always insert it, whether or not we intend using the button. This linen suture is put in wide of the button area and the necrotizing process, lest it become infected: that is why I use Pagenstecher linen—otherwise I should use catgut. [The anastomosis was made by means of the Murphy button, and a running stitch was inserted outside of the button; incision in abdominal wall closed without drainage.]

RECAPITULATION

Let the record show that the blood in the stomach-washings came from the ulcer, as it was interpreted by us, and that the color was not due to fecal contents; that there was no distention of the intestine below the area of the volvulus, which began about 14 inches beyond the duodenojejunal flexure; that the zone of the volvulus was distended, though not strangulated; that we untwisted the volvulus; that after performing posterior gastrojejunostomy by the button method we covered up the ulcer-bearing area by plicating over it the gastrohepatic and the gastrocolic omentum; that the ulcer had a diameter of a silver half-dollar and was of the deep crater type; and finally that the ulcer began on the gastric side of the pylorus behind and went downward and forward along the anterior wall to the pylorus.

POSTOPERATIVE COMMENTS

The patient was given saline intravenously while still on the table: we believe that this is the proper time—not to wait until the patient gets cold and clammy, but to restore him before he shows urgent signs of needing it. That sounds like a Celtism, but it is correct.

Postscript.—Recovery was uneventful. The button was passed on the thirteenth day, and the patient left hospital perfectly well one month after operation, on October 14, 1915.

PERIDIVERTICULITIS OF SIGMOID — INCISION AND DRAINAGE; INTESTINAL OBSTRUCTION — RELEASE OF GUT — COLOSTOMY AND ENTERO-ANASTOMOSIS BY TWO-STAGE METHOD OF MIKULICZ

Summary: Clinical history of patient; examination; comments—napkin-ring cancer *vs.* diverticulitis of sigmoid; operative treatment of diverticulitis; difficulty of draining a diverticulum of sigmoid; the short, thick mesosigmoid in diverticulitis; danger of dissemination of cancer in excising microscope specimen; advisability of two-stage intestinal resection in the corpulent; first operation—draining of abscess-pocket; recapitulation; postoperative comments—B. coli type of infection characterized by great infiltration with but little pus; cancer often mistaken for diverticulitis of sigmoid; great tissue-induration in actinomycosis; lipolytic necrotization of tissues by trypsin from pus; no liquefaction of tissues occurs in infections that do not provoke the trypsinogenic polymorphs; second admission—history of patient since first operation; examination; comments—now confronted with intestinal obstruction; avoidance of intestinal resection in presence of pus; second operation—site of obstruction found and proximal and distal loops released; resection (two-stage operation): both open ends of bowel retained in wound; followed by the insertion of a Dupuytren clamp, producing a lateral anastomosis of both "legs" of the intestine. Spontaneous closure of fecal fistula, metastases from cancerous large intestine sparse; recapitulation; postoperative comments.

CLINICAL HISTORY OF PATIENT

The patient, a male fifty-three years of age, was admitted to Mercy Hospital June 27, 1915. The family history is negative. Sixteen years previously the patient suffered from pleurisy, and until two years ago indulged excessively in spirituous drinks.

Ten months ago, in August, 1914, while riding in a motor, the patient received a severe jolt, and a short time later noticed cramps which radiated from the left lower quadrant of the abdomen to the pelvis (rectum). These cramps occurred at times immediately after meals, and at other times he had to leave the table on account of the severity of the pain.

A month after the trauma, in September, 1914, the patient suffered from these pains for four or five weeks and then consulted a physician, who prescribed medicine which seemed to relieve him until five weeks ago, when the cramps recurred. These pains always occur immediately after the patient has partaken of a hearty meal, and not when he has eaten sparingly. In its location the pain does not correspond with the location indicated by the symptoms which occur after meals. The pain is referred to the lower left quadrant, and is nearly always preceded by borborygmus, or associated with it. The bowels are constipated, the stools being watery, and occurring in small, scybalous masses resembling sheep stools: blood has not been present. Upon examination his physician discovered a mass in the left iliac region which measured approximately 6 by 2½ inches.

Examination by Dr. Murphy (June 25, 1915).—In the left iliac fossa there is a mass which is oblong and which is apparently two inches in diameter: it seems to be located high up in the sigmoid flexure. High (14-inch) proctoscopic examination is negative, and no blood was found in the rectum. The condition from which the patient is suffering appears to be either diverticulitis or napkin-ring carcinoma of the sigmoid flexure. The leukocyte count today is 11,400.

COMMENTS

Dr. Murphy (June 29, 1915): This patient recites a very peculiar history—one that is peculiar by virtue of its irregularities. The first attack occurred in August, 1914, with pain in the left lower quadrant of the abdomen, but soon passed off. The patient remained well until May 15, 1915, when a sudden attack occurred, and he has not been well since. It is now nearly seven weeks since the onset of the present attack. There is a low degree of leukocytosis.

The kind of neoplasm that involves the sigmoid is usually a cancer of the napkin-ring type—the small contracting and constricting carcinoma. What is the diagnosis? The diagnosis made in the office was diverticulitis of the sigmoid, and I was much gratified this morning when, upon entering the patient's room, I found his physician, Dr. Quine, of the same opinion, so that we both had made the same diagnosis independently. This is supported by the leukocytic count of 11,000, which should not be present with a simple carcinoma. If it be diverticulitis, I may perform one of two operations—resect the diverticulum or merely open and drain it—depending upon its location. Unfortunately, a diverticulum involving the sigmoid is not easily drained: it is usually situated on the mesenteric side of the bowel,—rarely on the convex side,—so that the diverticulum extends from the gut-lumen into the mesentery and between its layers. If this patient yields the usual findings in diverticulitis, we shall encounter a short, thick mesosigmoid—one so short that it will prevent the bowel being dragged into the operative field. I trust that it will not be necessary to perform resection. We have had a number of similar cases that have been opened and drained and have followed up a number in their postoperative careers.

I recall some of my very earliest experiences with cases of diverticulitis of the sigmoid, which I saw before knowing of the condition as a clinical entity: I diagnosed them as inoperable carcinoma, and the patients kept on living years afterward, convincing me that I did not know very much about diverticulitis in those days. If you suspect the presence of carcinoma, you cannot excise a specimen for microscopic examination unless you are going to follow up immediately with a radical operation, because you will disseminate the cancer and thereby bring about the death of the patient.

OPERATION

The patient is so very fat that it is perfectly justified to say that one does not know whether to cut or to "blast." There is the anterior superior iliac spine: here is the navel. We are going to incise through the rectus muscle. . . . There is its anterior sheath and here is the posterior sheath. That artery which we clamp and ligate is a branch of the deep epigastric. . . . If we must perform resection here we shall make it a two-stage operation, and not a primary operation, because this obese type of patient offers a poor surgical risk and does not stand the one-stage operation well. [Incises parietal peritoneum and exposes sigmoid flexure.] There you see what is apparently an inflamed diverticulum with a little agglutination on the outer surface of the sigmoid. I shall pack around this and explore by separating the adhesions. Now the pus is escaping. [The pus is sponged out and the field cleansed with a 5 per cent. phenol solution.] The intestine is indurated and completely contracted at this point. The mesentery is infiltrated, thickened, and short. It does not permit of mobilization. I shall insert a drain in the abscess-cavity.

RECAPITULATION

Let the record show that this indurated inflammatory mass was situated on the outer side of the sigmoid flexure; that it had widely invaded the loose cellular tissue behind the peritoneum and the tissues round about, and that there was an enormous mass of adherent omentum in the zone of infection.

Let the record show further that the operator inspected the field on closing to see that no sponges or instruments remained, and that Sister Laurian reported the sponges counted and correct.

The patient will be placed in bed in the sitting posture, with the head of the bed elevated eight inches.

POSTOPERATIVE COMMENTS

By virtue of the enormous degree of infiltration with but a small quantity of pus, this abscess conforms with the colon-bacillus type of infection. This inflammatory mass effected an incomplete obstruction of the bowel. We interpret the pathologic situation as being due to a perisigmoidal abscess—that is, an abscess from the inflamed diverticulum and not one the sequence of intestinal perforation due to carcinoma, and we base that interpretation upon the clinical history, rather than upon the physical findings. Of course, there may be a perisigmoidal sinus from a carcinoma, but such a lesion does not correspond with the history. The infiltration of the subperitoneal fatty tissue is very much greater here than one would expect with simple carcinoma, but cancer with secondary bacterial infection could give rise to the same type of infiltration as you see in this patient. A number of these diverticula have been resected as supposed carcinomata, and not until the pathologic specimens were microscoped was it discovered that they were diverticula.

In the early days of our experience we had in one case an excellent opportunity to observe the great extent of infiltration that is provoked by B. coli when it infects the subperitoneal fatty tissue. Many of you remember the venerable Dr. Peck, of Davenport, Iowa. Dr. Peck was one of the ablest surgeons of his day, and held the chair of surgery in the Iowa State University. He was treating a Sister of the B. V. M. order, who subsequently came here to Chicago to consult me *in re* a tumor in the iliocostal space of the lumbar region. The surface of the tumor showed large, red, dilated vessels, which were interpreted at that time, and still are interpreted, as surface-vascularizations accompanying a malignant growth. After examining the loin I concurred in Dr. Peck's diagnosis of malignancy. The mass became larger and larger and finally broke through the skin. By this time the wood-like mass involved the entire area from the iliac crest to the vertebral bodies, and from the anterior superior spine up to the costal margin. After perforating the skin it began discharging small amounts of offensive pus. That was before appendicitis was recognized as a clinical entity. Subsequently the abscess discharged a couple of drams of thick, offensive pus, and two typical, round, smooth appendiceal fecoliths, and the patient recovered.

That case called my attention for the first time to the great extent of infiltration that occurs around B. coli infections of subperitoneal tissue, and since then I have observed the same manifestation very frequently, recognizing it by its producing an induration which, in extent, is larger in proportion to the quantity of pus present than that produced by any other type of infection with the sole exception of actinomycosis. An actinomycotic focus not larger than a filbert often produces an induration that is three, four, or five inches in diameter. These mycelial infections are not rapidly necrotizing lesions—that is, they do not provoke a leukocytosis of polymorphs, the cells which give off trypsin around the suppurating focus, and thus produce rapid necrosis of the infected tissues. It is the trypsin in the polymorphs that destroys tissues so rapidly: not the pus, but the trypsin in the pus. The most striking effect of this trypsin is its lipolytic or fat-splitting action. The goblet-cells of the fatty masses are attacked by the trypsin (steapsin) and finally succumb to necrosis from the lipolytic ferment. If, on the other hand, the infection is not of the type that provokes the trypsinogenic polymorph leukocytosis, then the extensive central liquefaction which occurs in other types of pus is absent. In operating upon actinomycotic masses you will often feel that you are going to liberate a great quantity of pus: you keep cutting deeper and deeper and finally find a few drops of pus in the center of the induration, and will be perplexed until you see the little yellow granules roll out from the indurated tissues, indicating that the mass is due to actinomycotic infection.

Second Admission (*September 18, 1915*).—The patient returns to hospital complaining of continual griping pains in the lower abdomen, and also of borborygmi, as though the bowels were full of gas which incessantly wandered from side to side, and which was most severe in the left lower quadrant. Immediately after meals there arises a sensation of fulness in the epigastrium, with increasing distention of the stomach, which is accompanied by very severe cramps and moving pains that continue without remission until the bowels have been evacuated—thus often for thirty-six hours. The patient is obstinately constipated, and large doses of castor oil are necessary to move the bowels.

After leaving hospital there was a purulent discharge from the incision for four weeks, and then the wound healed and the discharge ceased. The patient feels that he cannot pass food through the stomach, and has not eaten solid food since leaving hospital. He is seldom nauseated and does not vomit. In the past two weeks he has become very weak. He now weighs 185 pounds.

Examination by Dr. Murphy (*September 17, 1915*).—The tumor is now movable, and the patient presents symptoms and signs of intestinal obstruction.

Comments by Dr. Murphy (September 20, 1915).—At the first operation there was found a perisigmoidal area of induration and a focus of suppuration just to the outer side of the sigmoid flexure. Having planned a two-stage operation, we first evacuated and drained the abscess to relieve the patient of the immediate danger to life. Now he comes back again with the syndrome of intestinal obstruction, showing that this cicatricial contraction, neoplasm, or perisigmoiditic sequence of his infection—whatever it may be—is obliterating the lumen of the bowel.

At today's operation we shall either resect the bowel or else establish an artificial anus. In the presence of the previous suppuration one is not justified in performing intestinal resection if avoidable, for fecal fistula with its attendant dangers to life is most liable to result.

This patient has an enormous *panniculus adiposis*, and mesenteric fat that is 1½ inches thick.

Second Operation.—[Patient in Trendelenburg position.] With the patient under ether I am enabled definitely to feel the mass which, while seemingly fixed before the anesthetic, now appears movable. I am making the incision to the inner side of the original scar, incising more cautiously than usual because of the presence of adhesions from the recent operation. . . . There is the anterior sheath of the rectus muscle now shining in the field: we pass through its outer portion. We cover the surrounding skin-surface with towels secured to the wound-edges by clips, so that the skin will not contact with our hands. . . . I am displacing this rectus muscle inward: that gives us a good wide opening. . . . There you see the parietal peritoneum shining in the field. Now we hope to divide this peritoneum outside of the line of adhesions. . . . We have succeeded in opening into the free peritoneal cavity: there is an enormous quantity of subserous fat. Here is the line of organic adhesions corresponding to the site of the drainage-tube: we must free them. . . . Now we have freed the omentum from its attachment at the area where the focus of suppuration existed. . . . There is the loop of sigmoid distal to the point of obstruction: I think this loop is long enough to be brought up into the field for the purpose of performing intestinal anastomosis to circumvent the obstruction. Now let us go above the obstruction to inspect the proximal loop of sigmoid. . . . The bowel above is enormously distended with gas and cannot be readily brought down: possibly when I free some of the adhesions on its outer side I shall be able to mobilize it more easily. . . . I am now pushing the parietal peritoneum upward to let this proximal loop of bowel come into the field. Remember, the parietal peritoneum is practically avascular, since the blood-vessels approach the bowel from the median side. Now I have succeeded in freeing the proximal loop, so that both loops are free and in the field. We do not know how soon we are going to tear into the bowel, for its wall, previously perforated, is still friable from the inflammatory mass, so that we have packed off all the adjacent field. Now we are in the *brie* from the previous suppuration. . . . I am approaching this bowel from the outer or avascular side: that is where the former abscess was. . . . Now we have clearly in the field the intestine where we hope to make the resection and perform end-to-side anastomosis well away from the site of the tumor. This is a very circumscribed lesion. I am removing this enormous superabundance of fat that is so detrimental to an operation of this type.

Seen from the outside, the intestine is free from all manifestations of malignant infiltration: that is fortunate. There, on the inner side, is the line of cleavage of the mesosigmoid as it approaches the bowel. After dividing the bowel distal to the obstruction, we sterilize the intestinal mucosa by cauterization, and dispose of the stump left remaining after resection by inverting it and then secure it by a purse-string suture, just as when dealing with the stump of the appendix vermiformis, and retain the end well up to the level of the wound. . . . I am now freeing this mesosigmoid so as to obtain a better area for inversion down along the side of the bowel.

Let the record show that there are no metastases whatever to the mesenteric lymph-nodes.

Even if the tumor were malignant, the absence of metastases would still be compatible with malignancy, for the large intestine, sparse in lymphatics, is one of the sites in the body where a malignant tumor gives rise to late metastases, or none at all. Above the site of obstruction the bowel is enormously distended, being many times the normal diameter of the healthy sigmoid flexure.

Now we shall see what type of intestinal union we can make that will best meet the conditions as we find them. To perform a complete anastomotic operation at one sitting would materially hazard the patient's life; therefore, we shall perform the Mikulicz operation. The field is a very difficult one in which to effect an end-to-end or an end-to-side union, and if there be failure of union, it may mean a fatal outcome.

The descending colon has such a large non-peritoneal area where the mesosigmoid separates and becomes continuous with the parietal peritoneum that the patient is exposed to hazard. There is the mesentery of the upper segment, and here that of the lower one. I am going to suture the adjacent surfaces of these two segments of bowel together to isolate the peritoneal interspace, so that there will be no possibility of the small intestine coming in between these two "legs" of intestine from the midline. . . . I have finished suturing these two segments together, and the ends stand out of the abdominal wall like a double-barreled shotgun (Fig. 7).

Now we shall remove these intestinal clamps which held the segments of bowel together while we were joining them. The segments are sutured on the other side as well. Weeks later, when I apply the Dupuytren clamp, I merely compress these segments, make a necrosis-anastomosis (Fig. 8), and the fistula usually closes up of itself.

We now feel that we are rewarded in having primarily performed a two-stage operation instead of endeavoring to perform resection in the presence of pus: with this quantity of fat, resection in the presence of pus would have been a failure, and the patient would probably have died of sepsis, whereas now he has a very good chance. Such a fatal outcome would probably not have been due to intraperitoneal sepsis, but to cellulitis involving the subperitoneal and mesenteric fatty tissue. We insert two drains into the retroperitoneal fatty space, in addition to a tube placed behind and between the two segments of the intestine.

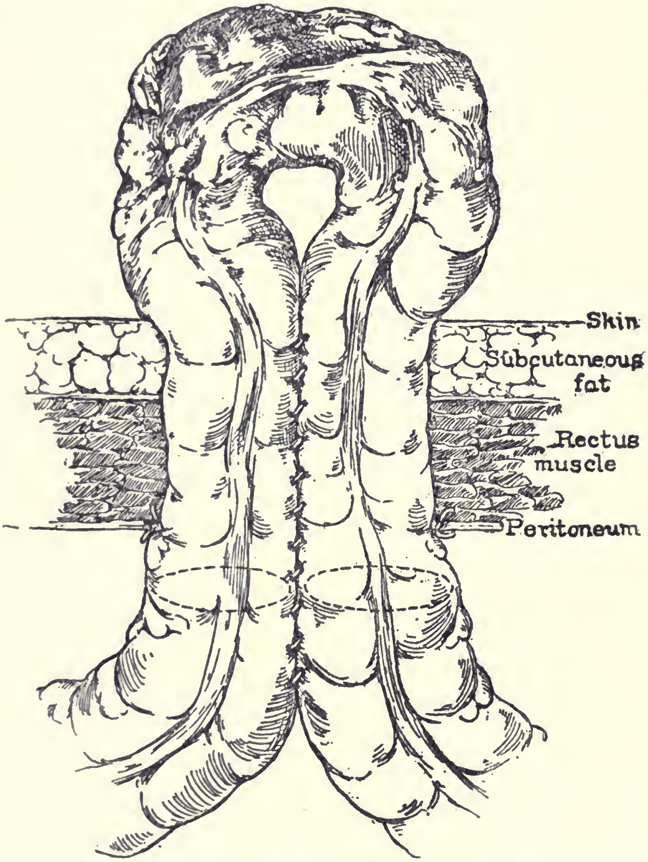

Fig. 7.—Tumor lifted out of abdomen, loops of bowel sutured into wound (Mikulicz operation) (C. H. Mayo, "Collected Papers by the Staff of St. Mary's Hospital, Mayo Clinic," 1912, 196).

Now we shall suture these segments of bowel to the parietal peritoneum, so that both will remain up here in the wound and be unable to retract. The contacting areas of visceral and parietal peritoneum agglutinate within a few hours. There is the parietal peritoneum: in suturing its cut edges we make an ectropion to prevent adhesions at the stitch-line. I am now including the peritoneal portion of the bowel in this stitch that closes the parietal peritoneum. . . . We must insert a rectal tube. The sheaths of the rectus muscle are being accurately reunited edge-to-edge. [Apposes skin-edges.]

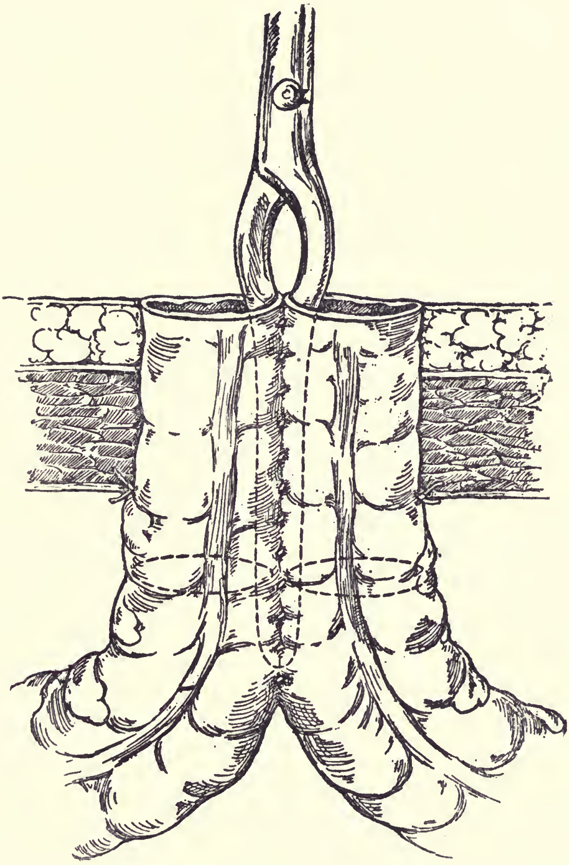

Fig. 8.—Tumor amputated, Dupuytren forceps passed into ends of bowel and clamped (Mikulicz operation) (C. H. Mayo, "Collected Papers by the Staff of St. Mary's Hospital, Mayo Clinic," 1912, 197).

Let the record show that in closing the operator inspected the field for sponges and instruments to see that none remained; and that Sister Laurian reported the sponges counted and correct.

RECAPITULATION

Let the record show that there was found an annular constriction of the sigmoid flexure; that on inspecting the field we found adhesions to the anterior abdominal wall, after freeing of which we incised the anterior parietal peritoneum and succeeded in exposing the mesosigmoid from the outer side; that there were no adhesions to the mesosigmoid on the inner side; that we brought into the field a zone which had been previously infected; that the mesenteric vessels were ligated, whereupon we were ready to free the upper and lower segments of gut, so that we could bring the tumor out of the abdomen; that we then examined the bowel carefully to see if we could perform end-to-side or end-to-end union safely, but did not consider such a union feasible, so that we decided to perform a two-stage operation, bringing both segments of gut out of the field; that we united the segments laterally with catgut sutures, both on the inner and outer sides, with the result that their mesenteric zones overlapped each other and the small bowel could not come in between the two segments of the divided large intestine; that the distal end of the bowel was cut off and turned in, as one inverts the stump of the appendix vermiformis; that we cauterized the stumps with the actual cautery to sterilize them; that we separated the segments below the site of the neoplasm and turned the neoplasm, granuloma, or stenosis, whatever it was, clear out of the wound for four inches behind, so that the sigmoid or descending colon is exposed for four inches above the tumor.

Because of the large amount of adipose tissue present I have sponged off this field with a 5 per cent. solution of phenol, for there is always a certain amount of danger wherever fatty tissue is exposed to B. coli infection.

POSTOPERATIVE COMMENTS

As shown from necropsy reports upon malignant neoplasms, 44 per cent. of cases of cancer of the sigmoid at the time of death are free from metastases of any kind in any position in the body—even in the regional lymph-nodes. With ablation of the growth in this patient, therefore, there is a much greater chance of freedom from recurrence.

This patient has had intestinal obstruction for several days, so that we must provide for the escape of gas at an early period by inserting a rectal tube. You cannot close the abdomen tight and keep it closed, because of the obstruction-syndrome that has existed.

This is a slow process. In twenty-four or forty-eight hours we shall remove that ligature. By that time all the operative field will be coffer-dammed. Then we shall cut the ligatures and insert a tube. At the end of two or three weeks we shall apply a Dupuytren clamp to both these segments of bowel, and then put one blade of the forceps into each segment and let both blades ulcerate out. If the patient should survive this operation, he has a good chance for a long period of life.

[*N. B.* (October 1, 1915).—Notwithstanding that feces are continually coming through the wound, we have obtained primary union. The stitches are removed today.]

Postscript (December 30, 1915).—The Dupuytren clamp was applied. The patient is having regular bowel movements per anum and there is but slight fecal discharge from the fistula, which is rapidly contracting.

URETHRAL CARUNCLE—ABLATION

Summary: Clinical history of patient; examination; operation—caruncle exposed, springing from posterior wall; urethra may be opened with same safety as ureter; importance of traversing sound tissue wide of caruncle during its ablation, to prevent recurrence; danger of traumatic stricture if too much urethral mucosa be resected; advantages of phosphor-bronze as a suture-material in urethra.

CLINICAL HISTORY OF PATIENT

The patient, a matron sixty-four years of age, was admitted to Mercy Hospital September 23, 1915. The family and past histories are negative. The patient has borne 11 children.

Since four years the patient has complained of frequent urination, and during the past year suffered from pain in the region of the bladder when distended with urine, and burning pains along the urethra during and following urination. The urinary symptoms have, however, been diminishing in the past month.

Ten days ago, on September 13, 1915, the patient noticed a bloody discharge from the vulva, and on investigating found a mass at the vulvar orifice, which was dark red in color and which protruded for about one inch. The bloody discharge has been present without remission: the amount of blood, however, is very slight—three or four drams a day. There has been no pain at all—only a sensation of a foreign body in the vulva. There has been no nausea or vomiting. The bowels are habitually constipated.

Examination by Dr. Murphy (September 23, 1915).—The uterus is small and movable. The perineal repair, which was performed many years ago, shows full cleavage with no erosion. On palpation there is great thickening and protrusion of the urethral mucosa, forming a urethrocele. A neoplasm protrudes from the external urethral meatus (Fig. 9, 1), and is melanotic in character, but I regard the melanosis as being due to the

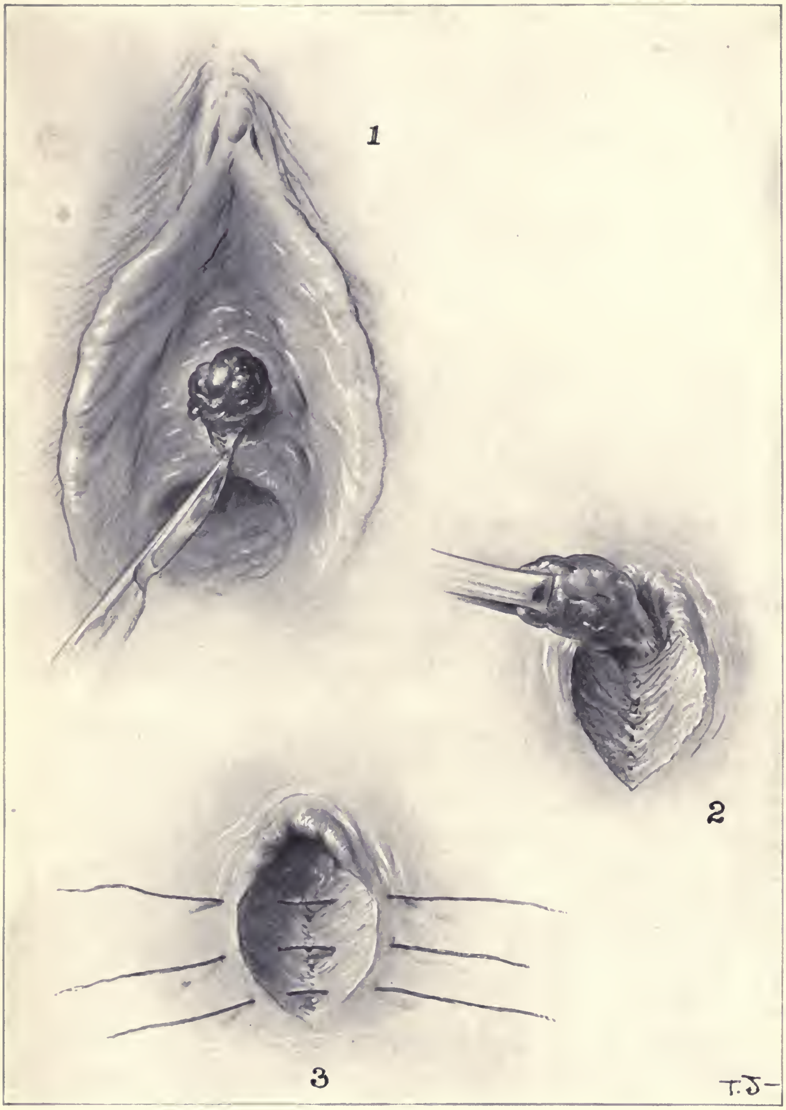

Fig. 9.—1, Caruncle found protruding from urethra—circumcised in healthy tissue; 2, caruncle freed to base-attachment in posterior wall of urethra; 3, phosphor-bronze sutures are introduced, including mucosa. (Sketches made at operating table.)

effects of strangulation, rather than to the presence of intrinsic melanotic cells. The tumor is apparently undergoing necrosis.

OPERATION

Dr. Murphy (September 25, 1915): [Patient in lithotomy position: vulva exposed.] There is the growth protruding from the urethra (Fig. 9, 1). We must open the urethra in an endeavor to determine the origin of the tumor: one may open up the urethra with the same degree of safety as when dealing with the ureter. [Incises urethra and explores with finger.] . . . . I am endeavoring to determine whether the tumor extends into the bladder. . . . It seems to spring from the posterior surface of the urethra on the left side and distal to the internal vesical sphincter, and I am cutting directly down upon it (Fig. 9, 2). . . .

It is essential to ablate the whole neoplasm, going beneath its base into sound tissue: otherwise there will be a recurrence of the growth. Care must be taken not to resect too much of the urethral mucosa, lest a stricture form: a circumferential patch of mucosa should always be left remaining. The tumor has been strangulated, and its lower half is necrotic. [Ablates growth.]

Now we are inserting phosphor-bronze sutures just wide of the margin of the incision and then out through the floor of the raw surface, dealing with the opposite side in the same manner (Fig. 9, 3). The advantages of phosphor-bronze are that it is non-irritating, since urine does not collect around it to decompose and irritate the wound, and also that it gives one an assurance of safety by its high tensile strength. There is one danger with this fine needle—that of breaking it. I include the mucosa in this stitch, instead of suturing it separately (Fig. 9, 3). . . . We have now reached the normal portion of the urethra.

[*Postscript.*—The patient made an uneventful recovery.]

LUXATION OF THIRD LUMBAR VERTEBRA WITH COMPRESSION OF CAUDA EQUINA—SPINAL DECOMPRESSION

Summary: Clinical history of patient; examination; comments—operation *pros* and *cons;* lumbar region of cord the least accessible to expose; exposure of site of compression; control of hemorrhage in spinal operations; laminectomy does not weaken spinal column; decompression of cauda equina; closure of soft parts—importance of incising skin perpendicularly instead of beveling it; dressing and after-care; recapitulation; postoperative comments—prognosis; length of time required for regeneration; order of regeneration of nerves according to their function—order of recovery of impulse-transmission when suspended by trauma just the reverse. Bibliography of cases of injury, disease, and neoplasms of vertebral column or its contents previously reported in CLINICS.

CLINICAL HISTORY OF PATIENT

THE patient, a male twenty-seven years of age, was admitted to Mercy Hospital August 4, 1915. The family and personal histories are negative.

Over five months ago, on February 24, 1915, while the patient was descending a coal-shaft in a cage, the latter caught on a projecting bar, which tilted it and threw him out. He fell all the way to the bottom of the shaft—a distance of about 50 feet—and thinks that he struck the ground in a sitting posture. After the lapse of a minute or two he regained consciousness and found himself sitting up before any one came to his aid. Girdle pains radiating from the back to the lower abdomen were present.

The patient was immediately taken to a hospital, and a diagnosis was made of fracture of the vertebral column. Examination revealed complete loss of both motion and sensation from hips to toes; there was also retention of urine and incontinence of feces. Power of micturition returned at the end of seven weeks, but at that time the bowels were not yet completely under control.

At the end of ten weeks after the accident sensation in the hips and the thighs and motion of the thigh-muscles returned.

At the end of twelve weeks after the accident the power to flex both knees was present, and the ability to sit up was gradually returning.

In the past four weeks the areas of sensation in both legs have extended down to the ankles. At present there is flaccid paralysis of both feet, but the motor as well as the sensory areas are gradually widening. Pain aggravated by motion centers in the lumbosacral region.

Examination by Dr. Charles L. Mix (August 16, 1915).—The patellar and plantar reflexes are absent, but the reflexes higher up are intact. The highest level of sensory loss is in the territory of the anterior tibial nerve: motion as well is lost in this area. There is bilateral toe-drop: in addition to the extensores digitorum longus et hallucis proprius, the tibialis anticus and the peroneus tertius muscles are paralyzed and atrophied. There is also atrophy of the peroneal and posterior tibial groups of muscles.

The diagnosis is a crushing injury to the cauda equina, involving as the highest territory the nerve-cells that preside over the distribution of the sciatic trunk through its popliteal divisions. The level of the lesion is opposite the third and fourth lumbar vertebræ: laminectomy of these two vertebræ is advised.

COMMENTS

Dr. Murphy (September 1, 1915): The level involved by the injury is low down, in the caudal zone, and this lesion contrasts beautifully with the case we have for tomorrow (*vide infra*), in which the level of involvement is just a little higher up: this case, too, occurred in a miner and resulted from a somewhat similar accident.

In considering the treatment of this injury the question arises, Should one operate? Had the injury occurred above the conus and instantaneously produced complete annular paralysis of both motion and sensation, it would mean that the cord was completely severed, and since the true cord has no power of regeneration, there would be no improvement if you operated, nor would there be any if you did not operate, so you had better not operate. If, on the other hand, the true cord is not cut, but merely compressed, early operation is much more urgently indicated than when the cauda is compressed, because the cauda, since its axons possess a neurilemma, may undergo degeneration below the point of compression, yet entirely regenerate when the compression is relieved. Lesions in the caudal zone should be operated upon early—just as soon as it has been determined that the injury *is* in the caudal zone: nothing is to be gained by waiting. In brief, injuries to the *true cord* demand either immediate operation or no operation at all; while in injuries to the cauda, operation may be postponed as long as in the case of any peripheral nerve when injured, and yet complete regeneration can ensue.

In this case the paralysis came on suddenly, it is true; but since the accident six months ago function has returned to a considerable degree and is still increasing, and the patient has control of micturition: the lesion, therefore, is probably *compression* of the caudal zone, and not division. Had there been a division in the caudal zone, upon approximating the ends of the divided nerve regeneration will occur just as uniformly as when you reunite a divided peripheral nerve. There is a definite reason for this. (For a full discussion of the prognosis of spinal cord injuries see vol. iv, August, 1915, pp. 737–739; for one on regeneration of nerves see *ibid.*, October, 1915, pp. 830–831.)

OPERATION

On examining this patient you note a widening of the interspace between the spinous processes of the twelfth thoracic and the first lumbar vertebræ; and that there is a little depression below the spinous process of the second lumbar vertebra, but that below this there is no deviation of the remaining spinous processes. The extent of surface depression cannot be so great as the extent to which the vertebra itself is actually found depressed upon exposure.

Of the various regions of the cord, the lumbar is the most inaccessible because of the large bulk of the erector spinæ mass, as well as the lordotic curve normally present. I have placed a mark on the surface that will indicate the level I wish to attack and prevent me from losing my bearings as I get deeper and deeper. [Median incision over spinous processes (Fig. 10).] In spinal cord operations the bleeding is often severe, and so I prefer tearing these spinal vessels to cutting them, thereby lessening the amount of bleeding. . . . [Clears away erector spinæ mass on each side until spinous processes and laminæ are brought fully into view.]

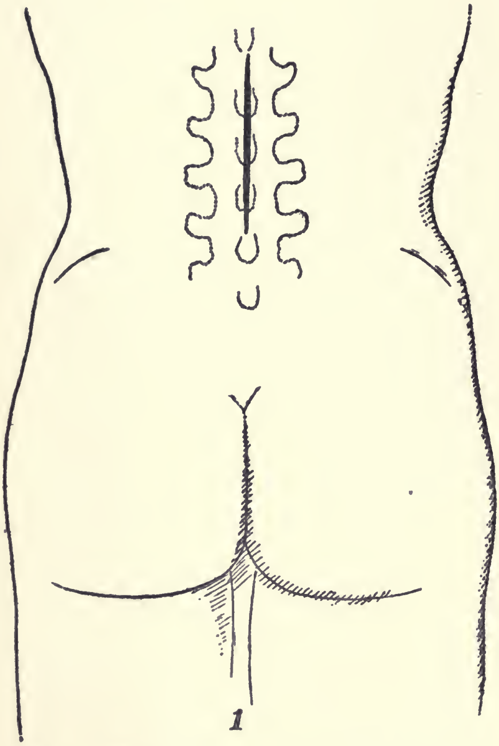

Fig. 10.—Median incision over spinous processes.

Notice the great depth at which we must work. . . . Here is the deviation (Fig. 11): it is exactly at the site indicated on the surface, just below the spinous process of the second lumbar vertebra, showing that the third lumbar vertebra is the one involved; we must, therefore, develop the field above and below that point. . . . There is the site of luxation: the third lumbar vertebra is displaced forward nearly an inch, and maintains the pressure upon the cauda (Fig. 12). Such compression, continued, will eventually bring about degeneration of the axons, but so long as the neurilemma is still present and unimpaired, even this continued compression does not render the axons incapable of regeneration.

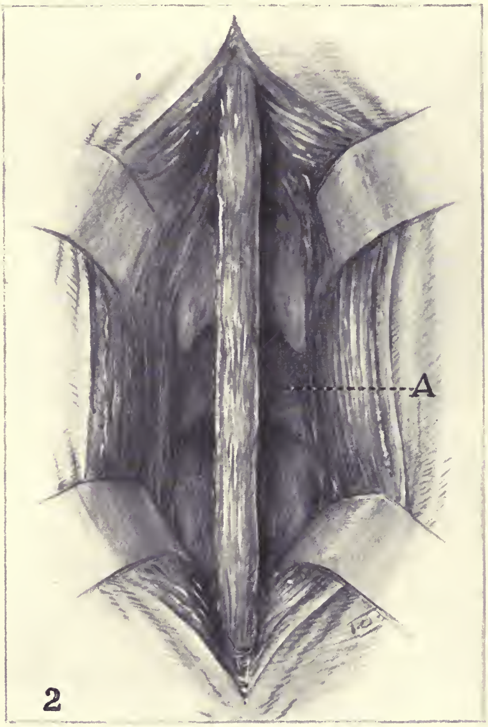

Fig. 11.—Retraction of erector spinæ masses reveals at "A" the depression due to anterior displacement of the third lumbar vertebra. (Compare with Fig. 12.)

In these spinal operations we control hemorrhage by the same method as in the removal of the Gasserian ganglion: by merely packing and waiting, the bleeding will stop. [Resects first the spinous processes of the first, second, third, and fourth lumbar vertebræ, and then the laminæ of the first, second, and third lumbar vertebræ.] That affords a very satisfactory decompression, with plenty of space to work in.

Owing to the pronounced luxation we feel very happy that we concluded to operate upon this patient; for while we cannot reduce the luxation, yet we can relieve him by performing decompression: you can perform decompression of the spinal cord just as readily as of the brain. One may remove these spinous processes as well as the laminæ without endangering the stability of the vertebral column—a circumstance that was formerly a great surprise to me, for one would naturally think that it must needs weaken the vertebral column considerably.

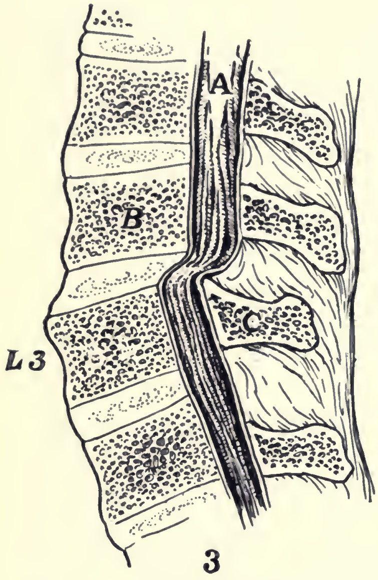

Fig. 12.—Third lumbar vertebra displaced forward nearly an inch, maintaining pressure upon cauda. A, Conus medullaris, terminating true cord opposite lower border of first lumbar vertebra; B, centrum of second lumbar vertebra; C, depressed spine of third lumbar vertebra. (Compare with Fig. 11.)

I must free the posterior arch of the firmly fixed luxated vertebra so as to get some remission of the pressure upon the cauda, and I must work very cautiously, so as to keep from traumatizing the cauda below, which has already been so much compressed. I am just freeing the fibrous tissue so that I can get the end of my elevating instrument beneath the posterior arch of the luxated vertebra. . . . I am taking many more precautions than I would have to take were it not for the presence of the luxation, lest I injure the filaments of the cauda. The patient has control of micturition now, and I might destroy that control by unbridled manipulations. We have removed the spinous processes and laminæ of the first, second, and third lumbar vertebræ, thus freeing the cauda from the pressure. There is no way of freeing the body of the luxated vertebra: it is situated too far anteriorly to be accessible, and is firmly fixed. We have done all we could by relieving the compression upon the cauda and letting it fall back into the canal. [Tests nerve-trunks of cauda with faradic current.] On applying the excitor you note contraction of the extensor muscles of the foot—an indication that there must be living axons, and a proof that there is merely suspension of transmission of impulses and not degeneration of the axons.

Let the record show that there was no cicatricial constricting band across the dura, as was found in a case previously reported in the Clinics (August, 1915, pp. 741–744).

We had a fresh case of this type in which we succeeded in effecting accurate reduction of the luxation of the vertebræ (vol. iv, February, 1915, pp. 109–123—illustrated).

Now we shall approximate these muscles clear across the area of decompression, beginning below, so as to get good muscular apposition in the midline. [Apposes cut edges of vertebral aponeurosis by a double row of (figure-of-8) sutures, and then the skin-edges.] I want to approximate the skin accurately for the full thickness of the derma alone, so as to try to obtain early primary union. Here as elsewhere in the body—particularly on the face and neck—in making the skin-incision it is very important to make the cut perpendicular for the full depth of the skin, and to avoid beveling it: should one bevel the skin, the process of repair proceeds more slowly, and the tendency to keloid formation is very much greater.

This powder—bismuth subiodid—is merely a desiccating medium, and when mixed with blood or serous discharge from a wound, it forms a firm cement, and does not irritate like collodion. This piece of gauze—wet with collodion—when laid across the wound acts as a splint, and prevents transverse separation of the skin-edges.

The greatest care will be exercised until the patient is back in bed. Every two hours he will be moved from one to the other side, in order to avoid continual pressure upon his sacrum. While shortly after the accident the patient had bed-sores, yet we feel that now, since the normal trophic conditions of the skin have been restored, bed-sores will be less liable to develop again.

RECAPITULATION

Let the record show that before incising the skin we recognized two external evidences of the injury—one in the increase of the interval between the twelfth thoracic spine and the first lumbar spine, and the second in the slight depression of the third lumbar spine and the widening of the interval between the spinous processes of the second and third lumbar vertebræ; that we therefore exposed from the first to the fifth lumbar vertebræ and removed the spinous processes of the first, second, third, and fourth lumbar vertebræ, together with the laminæ of all but the fourth; that the compression of the cauda was at the lower margin of the body of the second lumbar vertebra and was caused by the base of the transverse processes and laminæ of the third lumbar vertebra (Fig. 12); that the canal-space for the cauda was extremely narrowed, so that the pressure upon the caudal nerve-trunks was continual; that the dura had been lacerated; that we released the cauda from compression by performing a typical decompression of the zone involved; that in resecting the bony parts great care was taken not to injure the cauda; and finally that with the faradic current we were able to elicit a response in the group of muscles supplied by the anterior tibial nerve, which formerly did not respond to auto-impulses.

POSTOPERATIVE COMMENTS

I think that we can offer this patient a favorable prognosis. It will take from eighteen to thirty months for regeneration to occur: at the end of sixteen to eighteen months we should find muscular faradic reaction positive, but after thirty months there will be little additional positive faradic reaction.

According to their function nerves regenerate as follows: first, the trophic nerves; secondly, the sensory nerves; thirdly, the motor nerves. In suspension of impulse-transmission from trauma just the reverse order obtains.

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Impacted fracture of body of first lumbar vertebra. April, 1913, 275.
Concussion of spine with impacted fracture of vertebra. August, 1912, 545.
Compression of cord from traumatic angulation of first lumbar vertebra. February, 1914, 161.
Fracture-luxation of spine at twelfth thoracic vertebra. December, 1914, 1077.
Fracture-luxation of second lumbar vertebra with compression of cauda equina. See following case, p. 59.
Luxation of spine at second lumbar vertebra. Open reduction. February, 1915, 109.
Bullet in lumbar spine. August, 1913, 601.

II. Disease.

Cicatricial constriction of cord. August, 1915, 741.
Typhoid spine. June, 1912, 429; August, 1915, 745.
Pott's disease: Talk by Dr. Fred H. Albee. June, 1913, 455.
Tuberculoma of spinal column with compression of cord. December, 1913, 1011.
Tuberculous granuloma of vertebræ. August, 1915, 731.
Subcutaneous abscess following tuberculosis of spine. December, 1913, 1027.
Tuberculosis of thoracic spine with compression of cord (*vide infra*, p. 67).

III. Neoplasms.

Intradural cystic tumor. April, 1915, 368.
Bony tumor of spinal canal. August, 1915, 719.
Endothelioma of spinal cord. October, 1912, 695; August, 1913, 733 (contains table of tumors of cord).
Myeloma of cord. August, 1913, 709.
Intrathoracic sarcoma starting from vertebral column. October, 1914, 883.

IV. Congenital deformity.

Spina bifida; meningocele. April, 1913, 265.

FRACTURE-LUXATION OF SECOND LUMBAR VERTEBRA WITH COMPRESSION OF CAUDA EQUINA—SPINAL DECOMPRESSION

Summary: Clinical history of patient; examination; comments—prognosis favorable in division of cauda equina, but not in that of true spinal cord; laminectomy urgently indicated in *compression* of true spinal cord; guiding principles in surgery of spinal cord; operation—laminectomy; lesion opposite middle of body of second lumbar vertebra—dura ragged from laceration; dural adhesions encountered—compression relieved by freeing dura; importance of carefully suturing wound in dura and in tissues over vertebral column; recapitulation; postoperative comments—prognosis in this case; after decompression sensory filaments of caudal zone regenerate more rapidly than motor; the Gasserian ganglion and trifacial neuralgia; the spinal ganglia and effects of excision; law of Waller; avulsion of sensory root of trigeminus. Inadvisability of operating upon patient's fractured leg until trophic nerves have recovered themselves.

CLINICAL HISTORY OF PATIENT

The patient, a male thirty-three years of age, was admitted to Mercy Hospital August 25, 1915. The family and past histories are negative.

Over two months ago, on June 19, 1915, while working in a mine stooping to pick coal, a huge slab of slate which weighed five-eighths of a ton fell 14 inches, its edge striking the patient's back near the level of the tenth thoracic vertebra. There was also a compound fracture of the left tibia. The patient felt a sharp pain at the site where the blow was received in the back, but there was no pain elsewhere in the body. There was flaccid paralysis of the lower half of the body. Incontinence of urine developed and lasted forty-five days. The bowels did not move unless aided by an enema. There was no sensation in the rectum, and incontinence of feces was present.

Since the fourth day after the accident the patient has suffered from a dull, aching pain in the legs which, however, lasts but a few minutes. Sensation is returning in the right leg, but there is no sensation in the left. Sensation is present in the sole of the right foot. Flaccid paralysis involves both legs. The patient is unable to sit up. For the past month there has been no pain in the back.

Examination by Dr. Charles L. Mix (August 30, 1915).—The patellar reflexes, ankle-jerks, and plantar reflexes are absent. The cremasteric, epigastric, and abdominal reflexes are present. As to motion, every nerve beginning with the anterior crural above is involved, causing paralysis of the quadriceps extensor muscle and all muscles lower down. Sensation is preserved better (or perhaps better restored) than motion. At first there was no sensation in the anterior crural territory: now sensation is present even in the sciatic territory. There is a double toe-drop.

The diagnosis is a lesion of the cauda equina at the end of the spinal cord opposite the lower border of the first lumbar vertebra.

COMMENTS

DR. MURPHY (September 2, 1915): That history is practically the same as the one which was presented by the patient upon whom we operated yesterday (p. 49), except that the zone involved here is one vertebra higher up (*i. e.*, the second *vs.* the third lumbar)—just one vertebra below the termination of the true cord. There being a continuation of the disturbance from compression, we are going to take steps to relieve the latter.

The point which we emphasized yesterday was that if there is an injury in the caudal zone with compression, you have degeneration of the distal portion of the axons; but that if you remove the pressure, and if the neurilemma which is present in the caudal region is still intact, restoration of the degenerated distal portion can proceed from the regenerating activities of the neurilemma. If, however, the injury is above the conus,—*i. e.*, in the true cord,—and the compression continues (the cord not having been divided), you have degeneration with loss of power of regeneration, because in the true cord the axons have no neurilemma. Is that clear? Do you grasp the idea?

Where the true cord is not divided, but merely compressed, it is urgently indicated to perform laminectomy immediately. In such a spinal lesion the situation is very much like that of compression of the optic nerve in the presence of a brain-tumor, where, if operation is going to be of any benefit to the patient, it must be performed before the onset of blindness (vol. iv, August, 1915, 729).

In the surgery of the spinal cord just bear in mind a few principles, which will serve to guide you. Remember the two situations in the nervous system where axons have no neurilemma: first, the nerves of special sense; secondly, the nerve-fibers in the true spinal cord. All other peripheral nerves possess neurilemma-sheaths, and therefore are capable of regeneration when cut, provided their ends are accurately contacted.

The patient of yesterday presented an abnormal degree of lordosis at the site of the luxated vertebra, which indicated that the luxation had occurred in the forward direction: this patient, on the other hand, presents kyphosis, which signifies diminution in the diameter of the anterior portion of the body of the vertebra from a direct blow, with compression of the cauda. The skiagram corresponds exactly with the clinical picture, since it shows that the anterior portion of the vertebral body is flattened from above downward—a deformity that always gives rise to kyphosis.

OPERATION

There is the level of the first lumbar vertebra, and I have marked it on the surface so that I shall not lose my bearings when I reach the depths of the operative field. [Incision over spines.] There is the point of deviation of the spinous process of the involved vertebra: it is lower by one vertebral segment than was estimated from the clinical history. We must, therefore, go just a little lower down than we originally intended. [Cuts through vertebral aponeurosis.] The venous bleeding is very much less if you tear the tissues with a periosteotome instead of cutting them: one saves a considerable amount of blood that way. [Clears away erector spinæ mass on each side of midline outward as far as articular processes.] . . . Now I have exposed the spinous processes and laminæ on both sides. We stated yesterday that removal of the spinous processes does not weaken the vertebral column mechanically. [Resects spines and laminæ of exposed vertebræ.]

There is the point of compression, exactly where we estimated it, notwithstanding that the deformity is a little lower down: this point is directly opposite the tip of the conus medullaris. The cauda is not easily displaced from the vertebral canal because we are still working outside of the zone of compression. Now you see some of the normal areolo-fatty tissue with veins that exists between the dura and the wall of the vertebral canal, in the epidural space. The lesion lies exactly opposite the middle of the body of the second lumbar vertebra, where the dura is ragged from having been lacerated, and adhesions have formed. The normal dura slips out of the operative field without any trouble. In this case there is a little added danger that was not present in yesterday's case—namely, that of the development of a secondary cicatricial band across the line of fracture, with postoperative compression of the cauda equina.

We shall explore the column lower down to see that nothing is present which will interfere with the decompression operation. . . . I am coming upon strong, firm cicatricial and osseous tissue at the base of the spinous process below. . . . Now we reach the normal dura again: see it shining through! There is the normal dura above, and here is the normal dura below, the lesion. Now we shall resect a little more of the dura on the side, so as to free the cord and let it spring back more readily. . . . Next we shall approximate the lumbar aponeurosis so as to produce firm apposition of its edges across the line of division. This case is another very beautiful demonstration of the effects of compression of the cauda from fracture, and of the continuation of the pressure in the caudal zone, extending from the lower to the upper border of the second lumbar vertebra.

The moment I removed the bone that caused the compression the dura expanded and bulged clear up into the field—higher at the area of compression than at any other point; therefore, no scar-tissue had formed in the dura and there should be no postoperative contraction and fixation in the operative field. The scar was extradural. Should a scar form in the dura, however, and, contracting, compress the cauda, then we would have to interpose a strip of deep fascia in between the freshened edges of the dura ("Duraplasty," vol. iv, August, 1915, 741).

Now we insert the (figure-of-8) stitch, the lower loop of which includes the deep fascia (lumbar aponeurosis), while the upper loop includes the superficial fascia and the skin. By this method of suturing the tissues are brought into permanent apposition—layer to layer—and will unite in that relation. It is the tier suture that lends strength. From defective apposition of the tissue layers a hernia may form, so that it is important to suture carefully, to obtain firm primary union across the midline.

RECAPITULATION

Let the record show that the lesion was found to be compression of the cauda from fracture-luxation of the second lumbar vertebra which pressed the cauda back against the upper margin of the third lumbar vertebra to such an extent that the lumen of the vertebral canal was reduced by fully two-thirds, leaving it only one-third of its normal size; that there appeared to be a compression of the filaments of the cauda over the body of the second lumbar vertebra, which itself had been markedly compressed; that after completing the decompression there was no occasion for freeing the injured vertebra anteriorly after it had been resected posteriorly.

POSTOPERATIVE COMMENTS

Now what is the prognosis in this case? Good, owing to the continued improvement in the function of the sensory filaments that pass through the caudal zone, indicating that the cauda has not been compressed sufficiently to be severed. If the cauda were severed, there would have been no widening of the sensory zone area from the time of the trauma. Even had the nerves in the caudal zone been cut, the prognosis would still be good, for, owing to the presence of the neurilemma, regeneration would follow relief of the pressure. In the cauda equina the sensory filaments accompany the motor, with the result that if one set be cut, the other is cut with it. In the reëstablishment of function after relief of pressure the sensory filaments show an enormously greater power of regeneration.

It may be stated that the regenerative power of a sensory nerve is in direct ratio to the size of the ganglion whose cell-bodies preside over its axons and dendritic processes. This law is nowhere so strikingly illustrated as in the case of the trifacial nerve. In the case of the sensory filaments of the spinal nerves, the presiding cell-bodies reside in the ganglion on the posterior root, which corresponds, morphologically, to the ganglion of Gasser, and is in series with it. Of these spinal ganglia, the largest are found in the cervical region, owing to the presence of the brachial plexus. In the thoracic region the ganglia are small, but enlarge again in the thoracicolumbar and sacral regions, owing to the presence of the lumbosacral plexus.

The largest sensory ganglion in the body in proportion to the size of the nerve-trunk is the trifacial, or the ganglion of Gasser. The Gasserian ganglion has a potency of regeneration beyond that of any other nerve-trunk ganglion in the body. To realize its great regenerating power you need but consider trifacial neuralgia. Upon cutting and avulsing one of the three divisions of the trigeminus there occur, after a varying but usually short period, regeneration, then reëstablishment of sensation, and soon the invariable recurrence of the old familiar pain.

In the early days when osmic acid injections were advocated for the relief of trifacial neuralgia I remember that, after injecting the nerve, all the patients obtained immediate relief, and the relief continued for a varying period of time after the injection, averaging about fourteen months. Eventually, however, I received a letter from the patient about as follows: "I am so happy today that I must write to you. Sensation has returned in my face." As soon as I received such an optimistic communication I knew that the very next letter would say: "I am shocked at having had another stab of pain in my face." The regularity of this sequence showed that as soon as the axons were regenerated, back came sensation in the face, and back came the neuralgia.

The potency of regeneration of sensory nerves is very much stronger than that of motor nerves. The cell-bodies that preside over the motor axons reside in the anterior cornua of the spinal cord, while the cell-bodies of the sensory nerves are in the spinal ganglia, which are situated wholly *without* the spinal cord, on the posterior sensory trunks. Should you excise the posterior ganglion, the severed sensory nerve would never regenerate, because its presiding and nourishing cell-bodies are gone; and this is in keeping with the definite physiologic and pathologic law, first laid down by Waller, in 1850, that if you separate any nerve process from its presiding cell-body, the distal portion of the divided nerve process always degenerates, while the proximal portion continues to live. If, however, in the case of a sensory nerve, you should cut the spinal rootlets proximal to the ganglion—*i. e.*, between the ganglion and the cord—you would not get degeneration of the dendrites between the ganglion and the peripheral distribution, but degeneration of the proximal axons alone, between the point of section and their terminal telodendria, at whatever level in the cerebrospinal axis they are distributed.

This principle is turned to practical advantage in the removal of the sensory root of the Gasserian ganglion in the treatment of trifacial neuralgia. In this operation the problem is to avulse the sensory root from its attachment to the pons, where its superficial origin is in series homologous with the attachment of the sensory rootlets of a spinal nerve to the spinal cord. When you have finally avulsed the sensory root, the portion between the point of avulsion and the descending root of the trigeminus in the fasciculus of Rolando degenerates, in accordance with the law of Waller, and does not regenerate under any circumstances because there is no neurllemma of the portion that is in the pons, and therefore the neuralgia can never recur if you fully succeeded in avulsing the sensory root.

Nor does trifacial neuralgia recur after extirpation of the whole Gasserian ganglion—an operation suggested by Mears, in 1884, and first successfully performed by Rose, in 1890; but the difficulty in gasserectomy lies in the danger that is associated with elevation of the ganglion from its bed. The ganglion of Gasser rests upon the apex of the petrous portion of the temporal bone, in Meckel's space, where it is enveloped by two layers of dura with a prolongation of the subarachnoid space, and lies in close relation with the cavernous sinus on its inner side. Upon elevating the ganglion from its bed you are liable to lacerate the sinus, and blood wells forth into the field to such an extent that you cannot continue the enucleation. If, on the other hand, you pass over and beyond the ganglion until you come to its sensory root, by hooking and avulsing the sensory root according to the suggestion of Spiller (1898), and using Frazier's method of approach, there will be no possibility of regeneration on the proximal side of the ganglion because you have pulled the sensory root out of the pons, in which its fibers do not possess a neurilemma.

This patient has also an ununited fracture of the leg of over two months' duration—since the accident in June. We shall not attempt to operate upon the fracture until the trophic nerve filaments have been regenerated. To operate now would be unwise, first, because of the unsatisfactory condition of the skin consequent upon the compound fracture; and, secondly, because the spinal trophic centers that preside over the regeneration of bone are likewise disturbed, and failure of union would be liable to result, such as occasionally occurs in infantile paralysis after operation. In this disease, while the trophic centers are materially involved, yet the sensory centers remain practically free from involvement, because they are situated in the posterior portion of the cord, which escapes the ravages of anterior poliomyelitis.

TUBERCULOSIS OF THORACIC SPINE WITH COMPRESSION OF CORD—DECOMPRESSION OF CORD

Summary: Clinical history of patient; comments—development and course of scarlatinal streptococcic arthritis; progress of patient's tuberculous infection traced; deformity of spine varies with location of tuberculous focus in vertebral body; danger of opening granuloma of spine; operation—laminectomy, exposing site of compression of cord; recapitulation; postoperative comments—capacity of nerve-regeneration in cord *vs.* cauda; paralysis practically never produced by kyphosis; beneficent action of iodoform; ambulatory treatment of Pott's disease a failure; promising future for Albee's operation; the psoas type of cold abscess; the use of tuberculin.

CLINICAL HISTORY OF PATIENT

THE patient, a male twenty-two years of age, was admitted to Mercy Hospital September 26, 1915. The family and past histories are negative.

The present malady is of fourteen years' duration, and followed an attack of scarlatina in November, 1901, when the patient was eight years of age. During the attack he was delirious from high fever for about a week, and suffered from sore throat and, later, from pain in the left hip. There were no chills, and no abscesses formed. By Christmas he had recovered, but pain in the left leg lingered and gradually became so severe that three months later, in March, 1902, the patient was compelled to take to bed. The immediate application of Buck's extension-apparatus to the afflicted limb mitigated the pain. The patient remained in bed for seven months; and during that time there arose dull pain in the hip, but the joint was neither swollen nor red.

Six months later, in September, 1902, the patient was taken east for treatment of the left ankle, which was painful and swollen. Chills and fever were absent. As the result of the treatment he improved and was able to walk about on crutches.

Five months later, in February, 1903, the patient fell to the ground, and on getting up noticed pain in the left hip, knee, and ankle, and also in the right knee. To afford relief from the pains a steel extension-brace was applied from the axilla to the foot, was worn for two years, and then discarded for crutches. The condition of the hip gradually improved, but occasionally there was a dull pain in the left hip.

One year later, in February, 1904, a cold abscess formed and evacuated itself just anterior to the left great trochanter: a scanty purulent discharge was maintained for eight months.

Nearly five years later, in the fall of 1908, the same abscess-cycle was repeated, and this time the discharge lasted one year.

In June, 1909, pain and rigidity appeared in the thoracic region of the vertebral column. The pain soon disappeared, and the abscess healed subsequently.

Six months later, in December, 1909, the pain in the back returned, was increased by exertion, and gradually followed by kyphosis.

Five months later, in May, 1910, there were noticed prominence of the vertebral column at the tenth thoracic vertebra, lateral bending of the left leg, and eversion of the left foot. Four months later, in September, 1910, the leg and foot were straightened, and steel braces and a plaster jacket were applied and retained for eight months: the jacket extended from shoulders to hips, and upon its removal the kyphosis was found more marked. The present degree of kyphosis was attained three years ago, and since then the patient has worn a steel brace.

Seven months ago, in February, 1915, the patient experienced two severe chills and a fever of 102° F. He took to bed for a few weeks, and then was up and around again.

During the past six weeks the patient has been in bed. There has been pain in the back and in the left hip. The left lower limb gradually became numb.

During the past four weeks there has been loss of sensation in the left hip, thigh, and leg, which last feels numb and heavy. The cremasteric reflex is absent. Motor control of the thigh is limited to a slight degree of flexion. There is pain on motion, and the limb feels better when it is placed in the position of abduction. The right leg is the seat of needle-pricking sensations and of a sensation of constriction of the great toe. The bowels are constipated, and there is difficulty in urinating.

COMMENTS

Dr. Murphy (September 30, 1915): Arthritis of the left hip-joint followed the scarlatina, but did not come on immediately, for the scarlatina was at the height of its activity about Thanksgiving, November 26th or 28th, while the trouble in the hip did not appear until Christmas, showing that the infection in the hip was not of the type that commonly occurs with scarlatina—*that it was not of the streptococcic variety.* Scarlatinal streptococcic arthritis is wicked in onset, is associated with high fever, and rapidly destroys the joint unless the pus-tension be lowered by aspiration.

In scarlatina metastases occur when the patient is in the last days of the illness, and are manifested by pain in the joint and fever. When the metastasis begins thus, you know that it is not a tuberculous, but always a metastatic, infection. The line of treatment that should be instituted at once consists in immediate extension with traction to relieve the intra-articular pressure and immediate drainage. By drainage I mean relief of the tension of the products of infection on the capsule, which can be lowered by aspirating with a large needle and then injecting the joint with iodin, phenol, or 2 per cent. formalin in glycerin. *Never insert a drainage-tube!* Bear in mind that you are dealing with a streptococcic infection, and that by immediately lowering the intra-articular tension the infection is mastered within a few days, and the joint heals up without having undergone any damage. If, on the other hand, you permit the products of infection to remain under tension for more than the briefest period, from the destructive biotic and toxic effects of the microörganisms there result at once dissolution of the synovial membrane and eventually ankylosis; while if you put in a drainage-tube, you merely succeed in paving the way for additional infection from without.

If an acute streptococcic infection does not kill the patient quickly, it does not kill him at all. Irrigate the joint with a mild antiseptic if you like, but close it *without drainage*. In this class of cases a puncture (*paracentesis articuli*) is just as easy and effectual as an incision (*arthrotomy*), and the joint is restored to its normal condition.

This is not a new method of treatment. I recall such an instance in the case of a niece of mine who was treated by the late Dr. Fenger thirty-three years ago, and who was suffering from metastatic scarlatinal infection of the hip, with intense pain and high fever. Through a posterior incision Fenger opened the joint and washed it out with 5 per cent. phenol and then closed it: healing by primary union resulted, and the hip has given no further trouble from that day to this.

That was an example of the usually *immediate* joint-infection of scarlatina. The patient before us, on the other hand, did not suffer an immediate infection, for the joint was not involved until four weeks after the scarlatinal attack—the period required for the development and manifestation of tuberculosis.

The next phases in the course of this patient's disease were the manifestations of the tuberculous disease in the hip, continuing for a long time; next the manifestation of the same disease in the vertebral column; and then, after a long interval, the manifestation of involvement of the spinal cord itself. Remember, spinal paralysis resulting from tuberculosis of the vertebral column does not arise as a consequence of the kyphosis, but of the pressure of the granuloma. Furthermore, the granuloma is always situated in the anterior wall of the canal because tuberculosis of the spine invariably begins as a lesion of the body of the vertebra, and never of the posterior arch. When, as is usually the case, the granuloma forms in the fore part of the vertebral body, kyphosis results. When, on the other hand, lordosis ensues, the granuloma involves the hind part of the vertebral body, because the weight of the superincumbent spine telescopes the diseased vertebra in the direction of least resistance.

When Sir Victor Horsley began to operate upon these cases the treatment of paralysis resulting from Pott's disease was to curette away the granulomatous tissue, and we were inclined to follow his lead for a considerable time, but found that in those cases in which we opened into the granuloma there not infrequently occurred, as a sequence of the opening, a pyogenic infection of the wound and subsequently of the cord, and that the cord was destroyed where previously it was merely compressed.

OPERATION

[Incision in midline over spinous processes of lower thoracic vertebræ. . . . Erector spinæ mass cleared away on each side.] . . . . Now I have exposed the laminæ and the intervertebral joints at the site of kyphosis. I shall resect first the spinous processes, which may be removed permanently, and then the laminæ. [With bone-forceps snips through bases of spinous processes.] . . . . I am sawing obliquely through the laminæ (Fig. 13), and endeavoring to free them without injuring the cord. . . . I have now opened the canal, using a smaller instrument so as to lessen the liability of trauma to the cord. See that white mass protruding into the field! I have not yet opened into it, but I may do so. We have come directly down

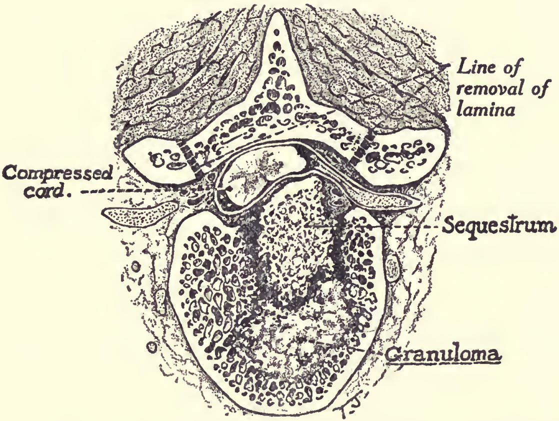

Fig. 13.—Tuberculous process involves chiefly left side of vertebral body, and consists of a granuloma in the fore part and a sequestrum in the hind part of the centrum. The sequestrum compresses left side of cord more extensively than right: it is separated from cord by meninges. (Composite sketch made at operating table.)

upon the affected portion, where the cord has suffered most from the compression of the sequestrum within the granuloma, which presses against the left side of the cord to a greater extent than the right (Fig. 13). [Continues exposure of cord above.] . . . . Now we begin to see the cord above the point of compression. [*Brie* wells forth into field.] We hoped to avoid opening into the granuloma, but it protruded itself too prominently into the field. Now we shall curette it out. . . . There is the sequestrum, pressing the capsule of the granuloma against the meninges (Fig. 13): I shall remove it as well. It is a little larger than a filbert nut, and was found compressing the left side of the cord, which, according to the history, is the side that has practically been out of commission, while the right side is just beginning to be attacked. By avoiding opening into the dural sac we shall have reason to hope that the spinal membranes will not become involved in the tuberculous process or by secondary pyogenic infection. The meninges are composed of white fibrous connective tissue, which fortunately offers stout resistance to tuberculous invasion.

Let the record show that the tuberculous process in the bone seems very soft and has not formed a very compact limiting wall.

One source of satisfaction about this operation is that, by removing the tuberculous débris which was compressing the cord, we are affording the patient an opportunity to regain the usefulness of his lower extremities, and if he should lose his life, it would be from the result of our efforts to restore the function of the lower limbs, which is a justifiable procedure.

In place of being extruded anteriorly the sequestrum was extruded posteriorly, into the left side of the lumen of the canal. Although I have seen many cases of granuloma of the spine, this is the first one I ever encountered in which the sequestrum was extruded into the canal.

I am scooping out as much of the *brie* as I can (there are several drams), and with the greatest possible care. . . . I am now working in the body of the vertebra, in front of the spinal canal and its contained cord (Fig. 13).

Let the record show that we succeeded in cleaning out the granulomatous débris without opening the dura; and that the sequestrum, which was compressing the left side of the cord, was being extruded into the left side of the canal.

After drying this cavity we shall daub it throughout with 5 per cent. phenol and then fill it with powdered iodoform. While iodoform has no curative value other than that accruing from the liberation of iodin, it is of great aid as a stimulant in the fibrous reparative reaction against tuberculosis, which, in every position in the body, heals by encapsulation, and not by phagocytosis. Not only does this medicament stimulate the production of the fibrous tissue which encapsulates the tuberculous focus, but, by its weak germicidal action, it inhibits the growth of B. tuberculosis.

We are endeavoring to check the bleeding by forcipressure in preference to using ligatures: a ligature or other foreign substance when inserted into the tissues in the presence of tuberculosis adds materially to the chances of secondary infection and unsatisfactory resolution. Now we are suturing the muscles and vertebral aponeurosis back into place with a (figure-of-8) stitch, thereby accurately apposing the tissues and obliterating dead spaces. [Closes skin wound with horse-hair sutures without drainage.]

RECAPITULATION

Let the record show that, after making the skin-incision, we cleared away the soft tissues above, over, and below the site of kyphosis and excised the spinous processes of three thoracic vertebræ—the tenth, eleventh, and twelfth—but resected the laminæ of only two, coming directly down upon the granuloma; and that the spinal cord, where compressed between the sequestrum and the laminæ, appeared very soft and mushy.

Let the record show further that two Horsley sponges were used, but that both were recovered before closing the wound. (For remainder of recapitulation *vide supra.*)

POSTOPERATIVE COMMENTS

The purpose of this operation was to perform decompression. We did not intend to open into the granuloma, but were compelled to, because in the course of the decompression it protruded itself right into the operative field and contained a sequestrum which required removal.

This case is very instructive because the diagnosis was so clearly revealed by the clinical history. We shall have the history read from beginning to end to show how uniformly it corresponds with the pathologic findings. [Stenographer reads history as detailed above.] . . . .

When the history is not in accord with the findings, there is usually something atypical in the pathologic situation.

The spinal axons of the tenth thoracic segment, which were compressed by the sequestrum and *destroyed*, will never be restored, because they belong to the true spinal cord and, being aneurilemmic, are totally incapable of regeneration. In the caudal zone, however, it is an entirely different proposition, for there the axons possess a neurilemma and are capable of regeneration (vol. iv, August, 1915, 737–739).

The spinous processes are not mechanically important in the support of the vertebral column, since without them the column remains strong enough to bear all the superincumbent weight.

This case verifies the observation, made years ago, that no matter how great the kyphosis is, it practically never produces paralysis, the latter in this case being due to the encroachment of the granuloma and sequestrum upon the spinal canal and its contained cord. The literature of Pott's disease shows very few instances in which the sequestrum protruded into the canal and compressed the cord to the same extent as in this case, where it could be felt encroaching upon more than two-thirds of the diameter of the canal, as both Dr. Kreuscher and myself determined.

After this patient's spinal disease had begun, under the ambulatory method of treatment there slowly developed kyphosis. The ambulatory treatment of Pott's disease is a failure, and we all are earnestly hoping that Albee's bone-graft method of immobilizing the spine will be soundly established as a means of permanent cure of this malady. At present the Albee operation is most successful in those cases in which the spine has attained its maximum growth; but whether it will be equally successful in cases in which the spine has not attained its maximum growth is yet problematic, although we have every reason to hope that it will, and are very anxious that it should, because the brace and ambulatory treatments of Pott's disease have been ——— failures, and into that blank you may insert any strong word of condemnation that you may desire. We all have practised those conservative methods of treatment of Pott's disease, so that we must bear a part of the odium.

The development of the kyphosis was neither accompanied nor followed by the appearance of a cold abscess from the spine. Such an abscess accompanying kyphosis is usually of the psoas type, and forms before, rarely behind. Many of those accompanying lordosis, on the other hand, form behind, the reasons being, as stated above, that in kyphosis the focus of tuberculous softening is situated in the anterior portion of the vertebral body, while in lordosis it is in the posterior portion.

Let me show you what happens and why. When the tuberculous process lodges primarily in the anterior portion of the vertebral body, any resulting cold abscess burrows in this direction,—anteriorly [indicates on bone-specimen],—and if the tuberculous focus be in the lower thoracic or lumbar region of the spine, the abscess enters directly the sheath of the psoas muscle, and therefore appears as a psoas abscess: when the focus develops in the posterior portion of the vertebral body, however, the resulting tuberculous *brie* burrows, as it did here, through the anterior wall of the spinal canal, enters the canal, and compresses the cord. The compression of the cord began about six weeks ago, and resulted from the sequestrum being extruded into the spinal canal. The left side of the cord was first affected by the compression of the sequestrum, and was slowly but surely put out of commission, as the gradual loss of sensation and of motion showed. Just before operation manifestations of loss of motion and sensation appeared on the opposite side as well. Just as sure as the rising of the sun, had this compression continued unmolested, there would have resulted complete transverse destruction of the cord, with complete and permanent paraplegia.

In the presence of lordosis the patient often gives a history of having fallen on the buttocks, the shoulder, backward or forward, striking upon the elbows and knees.

Some years ago a patient of ours presented the following history: One night he went out to the stable to work. During the day the children stretched a rope across the stable-door. Striking the rope, the patient fell forward, landing upon both elbows and knees. Immediately pain appeared in the back, but quickly subsided. During the course of the next two months the pain reappeared and slowly increased in severity; lordosis gradually developed, and then fixation of the spine, and finally compression of the cord. By the fall the patient injured the posterior portion of the bodies of his spine, a tuberculous process began, developing in the posterior portion of one of the vertebral bodies, and the softening extended backward, giving rise to lordosis from telescoping due to the weight of the superincumbent spine. At operation we merely decompressed the spinal cord. Ordinarily, we do not encroach upon and curette away the granuloma because the tendency of every tuberculous process is toward spontaneous healing, provided favorable conditions have been established. It is only necessary to relieve the pressure, so that during the further progress of the tuberculoma no pressure upon the cord can arise. Decompression, therefore, should be performed early—just as soon as the patient shows signs of beginning paralysis.

The alternative of operation is to apply a plaster jacket, enforce absolute rest, and institute tuberculin treatment. No external means of fixation has ever equaled the plaster jacket. The ordinary brace and other mechanical devices afford the patient only temporary and intermittent support, while in the mean time the destruction goes on unchecked, and eventually there develops, as in this boy, a superlative degree of kyphosis. Had this patient been kept in the recumbent position from the beginning, the kyphosis and the untoward result (compression from the sequestrum) would have been prevented. Unless we are going to adopt Albee's method, the recumbent position, with external (jacket) support and dietetic and tuberculin régimes, is the proper treatment for tuberculosis.

Tuberculin is one of the most potent remedies if properly administered and supervised, but one that is alarmingly destructive if improperly used. I may say that it seems to be a very difficult matter for physicians to digest a medical article correctly, so that after having read it they are able to follow the instructions to the letter. In reply to many physicians who have corresponded with me *in re* the proper mode of administration of tuberculin, I have found it necessary to have the instructions printed *double leaded* that tuberculin should be given but once a week and not every other day. When a physician reports that the patient is going to pieces on the tuberculin treatment, I know that the reason is that the patient is not allowed enough time between the injections for the proper opsonic reaction, or that he is receiving too large doses.

While tuberculin is a remedy of the greatest potency, yet there is no average dose, and the latter must be controlled by the opsonic index and degree of reaction on the part of each individual patient.

Postscript.—The patient made an uneventful recovery. There was great improvement in motion before he left hospital. He had obtained control of the feces and urine. He has, however, shown manifestations of a reëxcitation of the process in his old hip-joint lesion.

[A case of tuberculoma involving the seventh thoracic spine was reported in vol. iv, August, 1915, 731–740.]

ELONGATION OF CAPSULE OF HIP-JOINT SIMULATING CONGENITAL LUXATION—IMMOBILIZATION IN "FROG" POSITION

Summary: Clinical history of patient; examination; comments—description of skiagram; differentiation from congenital luxation; treatment by immobilization.

CLINICAL HISTORY OF PATIENT

The patient, a male child three and one-half years of age, was brought to the office November 10, 1915. He is the third child of healthy parents.

When the patient began to creep, the parents noticed a decided reluctance on his part to raise the left lower limb. On beginning to walk a limp developed, as though the left leg were shorter than the right. The little patient has never been laid up with the trouble, nor has he suffered pain at any time.

Examination by Dr. Murphy (November 11, 1915).—The right leg measures 18½ inches and the left leg measures practically the same. The patient's gait is similar to that of a child with congenital luxation of the hip. A skiagram taken both before and after applying traction to the limb shows that there is no luxation of the hip-joint, but an elongation of the joint-capsule, permitting preternatural excursions of the head of the femur (Fig. 14). While congenital hip luxations represent about 9 per cent. of orthopedic cases, elongation of the capsule without luxation is rare, though one would conclude, from Bradford and Lovett's work on the evolution of the hip-joint, that it might well be expected frequently.

Dr. Murphy: This is an unusually interesting case. In the first instance, on examining the skiagram you note that the head of the femur is situated a little higher up than usual, but that it is not out of the acetabulum; on looking at it a second time you note that the margin of the acetabulum is flattened out, and that the joint-capsule is elongated. By applying the tests for congenital luxation of the hip-joint, which Dr. Kreuscher has done, you find none to indicate luxation, but elongation of the joint-capsule, which appears, from the examination of many specimens by orthopedists, to be the first stage of many congenital luxations.

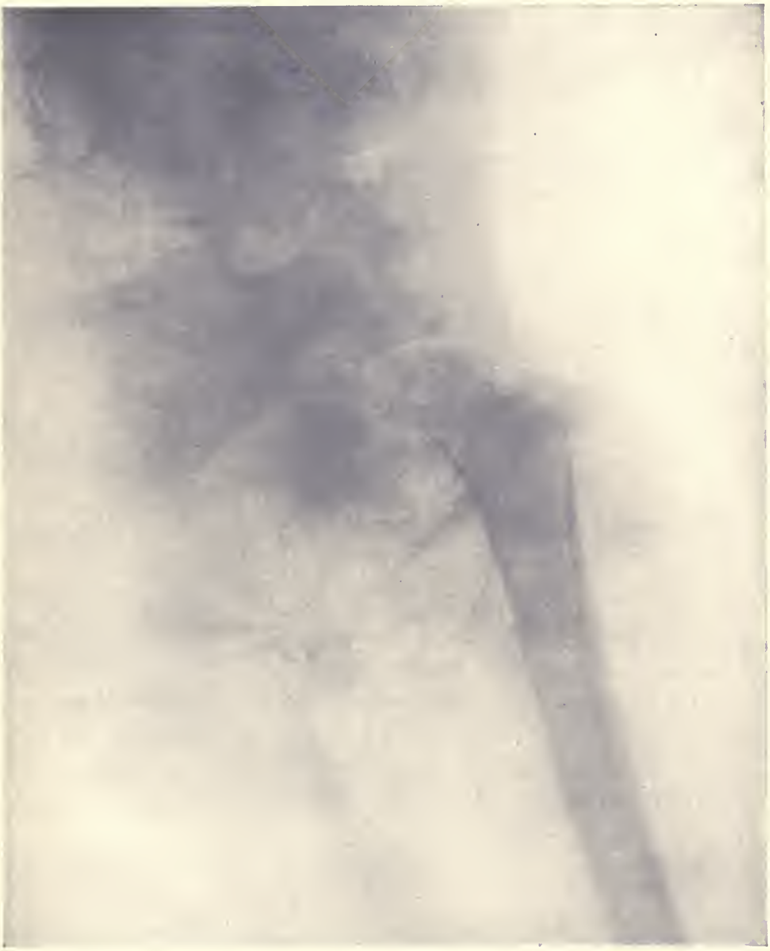

Fig. 14.—Elongation of joint-capsule permits preternatural excursions of caput.

TREATMENT

What is the proper treatment of this condition? The treatment should be prophylactic against complete luxation, and consists in immobilizing both limbs in a gypsum case in the "frog" position (vol. iv, December, 1915, 1170, Fig. 307) until there develops an acetabular cavity that is large enough to retain the head of the femur.

[A gypsum case was applied by Dr. Kreuscher.]

ANKYLOSIS OF HIP-JOINT, DENSE AND FIBROUS IN TYPE, FROM ANCIENT INFECTION—ARTHROPLASTY BY THE FAT-FASCIA FLAP METHOD—TALK ON TECHNIC OF ARTHROPLASTY OF HIP-JOINT

Summary: Clinical history of patient; comments—discussion of diagnosis; superiority of clinical over machine-made diagnosis; outline of plan of operation; operation—cicatricial tissue encountered; fibrous but no bony ankylosis found; importance of freely excising capsular ligaments; cicatricial tissue excised and fat-fascia flap interposed; recapitulation; postoperative comments; talk on technic of arthroplasty of hip-joint.

CLINICAL HISTORY OF PATIENT

The patient, a male twenty-three years of age, was admitted to Mercy Hospital October 25, 1914. The family and the past histories are negative. The patient has had no trouble with his teeth and denies venereal disease.

Thirteen years previous to admission, in August, 1901, the patient fell backward, striking upon the coccyx and left hip, but immediately got up and was able to walk again. The pain from the injury was present for two months, when, one night in October, 1901, there suddenly appeared a sharp, shooting pain in the left hip, radiating down the front of the thigh: this pain recurred and became spasmodic, and with the pain there was a tendency to flex the thigh upon the trunk, and there were marked twitchings around the hip. A physician dressed the limb in extension and applied a 10-pound traction-weight. The pain subsided, but the patient remained in bed all winter. There was no chill or fever at any time. Previous to the fall in August there had been dull, aching pains in the left hip-joint.

About six months after the fall, in the spring of 1902, an ambulatory splint, designed to retain the fixation of the hip and the extension of the limb, was applied, so that the patient could get up and be about. In November, 1902, the splint was changed, allowing motion at the hip. The hip was not painful, and the motion was good. One year later, in April, 1903, the splint was removed and discarded.

During the summer of 1903, while in Spain, the patient had fever ("rheumatic"?) with pain in the heels: he was sick about three weeks. Walking was painful.

From June, 1903, to 1906, the patient was active in athletics, rowing in a shell (sliding seat), skee-jumping, and playing football. In the summer of 1906 the dull ache that was originally present in the left hip and lumbar region reappeared. There was no history of a definite infection at any time.

Eight years ago, in the fall of 1906, while playing football, the patient noticed that the left leg was becoming shorter, although there was good motion in the knee-joint. There was a slight degree of pain, with some contraction of the hamstrings. Within a few days he also noticed that the left hip seemed flexed and that walking was painful.

In February, 1907, passive motion of the knee-joint was instituted, and the tendons about the knee were stretched. The hip was immobilized in a gypsum case for six weeks, during which time the patient was in bed. While the pain in the hip subsided, yet the aches by night were still present.

During the next year, 1908, the patient's condition became worse, and the left hip and lumbar region were particularly affected.

In April, 1909, the hip again became flexed and the seat of acute pain, but, as usual, there was no history of chills or fever. Again a gypsum case was applied, and following its application the pain in the hip subsided. The patient retained the case throughout the summer and fall of 1909, and remained in bed until November, 1909, after which time he was able to be up and about, and to put weight upon the hip without pain ensuing.

Two weeks after being up and about the patient had pain in the right hip, which gradually became worse until December 25, 1909, when there appeared the same spasmodic pains such as he had previously complained of in the left hip. These pains involved both the right hip and knee, and were also present during motion. Traction by means of Buck's apparatus was then exerted upon the right lower limb, and later a gypsum case was applied. The case was removed from the right hip in July, 1910, and upon its removal the hip and knee were found to be stiff. He was then up and about on crutches with two stiff hips and two stiff knees. At this time, too, the right knee began to swell. The patient was given tuberculin treatment, but without results, as should have been expected, since the history already indicated that this was not tuberculosis.

In October, 1912, Jones's operation was performed upon the right hip-joint. Seven weeks after the operation there was free motion in the hip and the patient got up and went about.

Six months later, in April, 1913, Murphy's operation of arthroplasty was performed upon the left hip by the same operator, and eight days after operation chills and fever appeared and the wound began to discharge pus. Ten days later there was fever of 104° F., the discharge from the wound increased in amount, and the patient was in hospital until June, 1913, with the limb in an extension-apparatus. Within two or three days after the chills acute, sharp pains appeared in the right hip, arms, and neck, and were present also on motion. Bacterins were prepared from the discharge from the hip, and following their administration the sharp pains in the arms and neck disappeared.

Seven months ago, in March, 1914, a sequestrum of bone was removed from the right hip, and in April the discharge stopped and the wound healed. There is still some pain when moving the legs. There is no history of any infection whatsoever preceding the original injury in 1901.

COMMENTS

Dr. Murphy (April 28, 1915): This patient gives no history of a primary sore throat just preceding the onset of the multiple and recurrent metastatic arthritis. We do not know the source of the infection—whether it came from the tonsils, the teeth, or the nose is problematic: it was not Neisserian. The patient was put upon tuberculin treatment: there was no occasion for putting this patient upon tuberculin treatment, for a patient who gives a history of disease traveling from one joint to another, getting well and breaking out again, is not suffering from tuberculosis. A patient with joint-tuberculosis is never incapacitated in a day, as this patient was: tuberculosis in a joint never incapacitates a patient before the third, fifth, or seventh week after the injury or after the first appearance of pain or soreness. Acute metastatic arthritis—if severe—incapacitates the patient within forty-eight hours, so that, given a clean-cut history, one can diagnose the disease two months, one year, or even a quarter of a century after it occurred. We are nowadays endeavoring to have too many machine-made diagnoses in place of sifting through the clinical history of the patient, like Trousseau was wont to do. Nothing is more refreshing than to peruse Trousseau's work on Clinical Medicine: one can now pick out the cases and, according to their clinical course, as described by that author, establish them upon a modern bacteriologic basis. Do not think that you must have the pathologist and the bacteriologist right at your elbow. There are some things we can determine without the aid of the laboratory. The laboratory is of assistance, but the clinical course of the disease takes precedence over all other considerations in establishing the average diagnosis.

In the left hip-joint the Murphy operation of arthroplasty was said to have been performed: the head of the femur is in the acetabulum, but there is practically no motion. My plan today is to see if I can obtain enough connective tissue around the joint to act as an interposing flap for an arthroplasty, or else to divide the cicatricial bands so as to establish some degree of motion. The patient is a fine fellow, and has endured a great deal of suffering. An operation, which was to have been the Murphy operation, was performed, and was followed by infection; this might have been the sequence of an infection already present in the joint tissues from his bacterial invasion. Upon the right hip-joint there was performed presumably a "Jones's" operation, which was equally fruitless. At present both hip-joints and both knee-joints are ankylosed. You may appreciate what stamina the patient possesses to endure that kind of suffering without the slightest complaint or depression of spirits. Judging from the scars, the incisions were evidently not of the type that we employ in our arthroplasties. This ankylosis is not bony, because when the patient is asleep and relaxed, there is obtainable some degree of passive motion, but even that degree of limitation of motion is equivalent to complete ankylosis.

OPERATION

[Usual external goblet-shaped incision made to expose hip-joint.] You see how disagreeable it is to work here: all tissues are cicatricial from the chronic infection. In the first instance it is difficult to reflect the skin-flaps and even to differentiate between bone and cicatricial tissue. [Using Gigli saw, divides top of great trochanter, and throws it upward together with the divided gluteal muscles.] There is what I take to be the cicatricial capsule of the hip-joint. The knee is so stiff that we cannot flex it for use as a lever or "crank." . . . I am now at the joint-line: this is better fortune than I expected to have at such an early stage in the operation. It is now evident that there is no motion in the joint, notwithstanding the absence of bony ankylosis: the joint is immobilized by a dense, fibrous fixation. In loosening the muscles and the ligaments by stretching them I am trying to avoid fracturing the neck of the femur. . . Using a chisel, I am excising that mass of dense, cicatricial tissue which forms an hypertrophied fibrous capsule for the joint. In our early cases of arthroplasty upon the knee-joint we did not excise enough of the capsular ligaments of the knee, so that we did not have good results, owing to the restricted motion and postoperative pain from inflamed nerve-endings left remaining in the scar and ligaments. In our later cases, however, we excised the ligaments more completely and obtained better results. With this great degree of cicatricial tissue formation there is no possibility of restoring motion by non-operative measures. The fault of the previous operation was that enough bone was not resected from the head and neck of the femur, and consequently fibrous union developed. I must obtain an interposing flap somewhere in order to prevent a similar reunion. [Luxates stump of cervix from acetabular cavity and then reams out acetabulum.]

Now I am outlining from the area below the great trochanter an interposing flap consisting of fat and fascia lata, the pedicle being above. . . There is the pedicled flap: it is of ample size to cover the acetabulum. [With long dissecting forceps carries free extremity of tongue-shaped flap around posterior border of reflected gluteal muscles, interposes it between stump of cervix and acetabulum, and, using catgut sutures, tacks its edges around margin of acetabular cavity.] We may now replace the stump of the cervix in the acetabulum, and you see that it adjusts itself nicely in place without undue necrotizing pressure upon the flap. [Closes wound without drainage.]

RECAPITULATION

Let the record show that we exposed the hip-joint with greater ease than we had anticipated; that we next freed and excised the extensive, cicatricial fibrous capsule which had developed around the new joint: this fibrous capsule was so dense and resistant that to cut it required great force with the heavy scissors; that after freeing and excising this fibrous capsule we luxated the stump of the femoral neck (the head having been previously removed) and exposed the acetabular cavity; that we then enlarged the acetabulum and rounded it out with the reamer; that we succeeded in fashioning the interposing flap from the fat and fascia lata below the trochanter; that we next inserted the flap into the joint, keeping the pedicle below the joint; that we succeeded in making the pedicled flap cover the acetabulum fully and without undue tension upon the pedicle; that the free extremity of the flap was sutured around the acetabular rim with catgut, and the cervix was then rotated home and rested upon the flap in the acetabulum without undue tension, notwithstanding the enormous quantity of cicatricial tissue present; that we were able to perform all this deep work without hand-contacting; that the retracted muscles were allowed to fall back over the joint so as to prevent reunion of the ligaments and re-formation of cicatricial tissue about the joint, and also to prevent ossification about the joint; that the trochanteric group of muscles, united in a cicatricial mass, was first divided to expose the joint, and later sutured in such a manner that they could not reattach themselves to the great trochanter; and finally that the wound was closed without drainage.

POSTOPERATIVE COMMENTS

The fundamental principle of this or any arthroplasty is the same as nature uses in preventing union of bones after a fracture. Remember, non-union after fracture is often due to fat and fascia or muscle being interposed between the ends of the fragments. Imitating nature, we fashion a flap of fat and fascia and interpose it in the joint, so that the bones cannot unite. The infection that followed the original operation in this case resulted in the formation of cicatricial tissue around the joint, and this cicatricial tissue, in turn, restricted motion to the same extent—for all practical purposes—as though there had been bony ankylosis.

This was a hard job, but not so hard as we had anticipated. Technically, the arthroplasty turned out splendidly, and should result in free motion. Both lower limbs will be dressed in the position of double abduction, with traction exerted by a weight of 20 pounds, to prevent necrotization of the fascia-fat flap from undue pressure during the process of repair.

Postscript.—Healing took place *per primam.*

TALK BY DR. MURPHY ON TECHNIC OF ARTHROPLASTY OF HIP-JOINT

The usual incision is U-shaped, the flap measuring about three inches in width and five inches in length, the base directed upward. The incision is begun an inch and a half above the trochanter and one inch behind it, extends downward to about two inches below the trochanter, passes under it and in front of it, and then upward to a point opposite the commencement of the incision. This places the trochanter approximately in the center of the U. In some cases the skin is divided downward at the lowest point of the U for an inch or two, so as to give us two lateral flaps and expose an area of fascia lata four inches in width and five inches in length. The knife passes through the skin and superficial fat, but not through the fascia lata in the original "U" skin-cut, but later, at the subcutaneous area, it goes through the fascia lata, and the flap is lifted up as one large thick mass. When the flap is lifted up, the point of attack is practically exposed.

Another incision which we have employed is made along the iliotrochanteric line—it commences at a point about one inch below and to the outer side of the trochanter, and extends upward for a distance of about five inches in a straight line with the anterior superior spine of the ilium. These incisions are employed interchangeably, as is demanded by the individual case.

The next step in the operation is to free the trochanter from the shaft, leaving its muscles attached to it.

A large, curved, flat, blunt-pointed needle (chain-saw carrier) threaded with heavy silk is passed around the base of the trochanter from behind forward, and the chain-saw is next brought into position. The trochanter is carefully sawed off downward and outward and is retracted upward out of the field of operation, carrying with it the attached muscles. The pyriformis and obturator muscles are then divided, and both ends are transfixed with sutures for subsequent approximation. The joint is now freely exposed, and the next step in the operation consists in incising the capsule of the joint around the neck of the femur and pulling it upward to the margin of the acetabulum, without, however, freeing it from its attachment to the acetabulum. It is merely loosened from the neck of the femur and stripped upward from the head of the bone, so that it can be interposed later between the head of the bone and the acetabulum, if needed, so as to assist in the formation of a new lining for the acetabular cavity.

The next step is the formation of a new acetabular cavity and a new femoral head. The first thing to be done is to separate the ankylosed head from the socket as near the normal anatomic line as is possible. This is done by chiseling out the bony tissue filling the acetabular cavity by means of an ordinary carpenter's or cabinetmaker's curved chisel, about 1½ inches in width.

With properly directed blows and sufficient force, the chisel is driven in obliquely toward the acetabular cavity for the depth of one inch all the way around the head, as near the normal conformation as is possible. When the chiseling process is completed, with the chisel as a lever and the thigh held by an assistant, the head is fractured out of the acetabulum and the acetabular cavity is then fashioned with a special globular drill or reamer, so as to receive the new femoral head, which will be similarly fashioned from the bony mass chiseled out of the acetabulum. For this purpose use is made of a specially constructed cup-shaped end-mill, making it possible to provide a new femoral head of normal conformation and smoothness.

These two instruments, used in fashioning the acetabulum and the femoral head, constitute, in reality, parts of the same appliance; the globular portion fits into the cup-shaped portion in such a manner that, unless the interposing tissues are in position, the fit is perfect.

The main reliance for obviating the recurrence of the ankylosis is placed upon the flap of the deflected fascia lata, which is made by splitting the original U-shaped flap. This flap consists of fascia lata and a layer of subcutaneous fatty tissue which formed the inner part of the original skin and fascia flap, the base of the U having been originally directed upward so that the nutrition of the flap is preserved as much as is possible to insure its continued vitality. Grasping the edge of the flap with tissue forceps, it is drawn into the joint, passed over the femoral head, and the edge of the flap may be sutured to the acetabular margin or to the remnant of the capsular ligament which is still attached to the neck of the bone with phosphor-bronze wire or chromicized catgut, thus forming a complete covering for the head and neck of the femur. When the head is placed into the acetabular cavity, this flap also serves as a lining for this cavity and reënforces the capsular ligament, although the latter is used mainly for the purpose of preventing a "locking" of the joint by the formation of exostoses on the acetabular rim following the operation.

The next step is to replace the trochanter, which, it will be remembered, was sawed off from the bone without disturbing the muscular attachments. Then the ends of the pyriformis and obturator muscles are reunited. The trochanter is brought down, fitted on to its original position, and secured in place by stitching the adjacent cut edges of the gluteal aponeurosis together by means of phosphor-bronze wire, while the superficial fascia is sutured with chromicized catgut, and the skin with interrupted silkworm-gut and horse-hair sutures. No drainage is used.

The field of operation is freely dusted with bismuth subiodid powder, and the wound is then sealed with gauze saturated with collodion. A large pad of 5 per cent. phenol moist gauze is placed over the hip, extending from four to six inches beyond the line of incision on either side. A sterile dressing is placed over all and held firmly in place by spica bandages and wide strips of adhesive plaster. The patient is then placed in the Rainey travois splint, and Buck's extension-apparatus, with 20 pounds weight, is applied to the limb in the usual manner, to overcome the involuntary muscular contraction of the flexors and adductors of the thigh, and to prevent pressure-necrosis of the newly interposed flap. The limb is dressed in the abducted position.

We always place the patient in this splint with both limbs abducted, for the reason that we have found that when only one limb is abducted, the patient unconsciously throws his body to the opposite side, so as to bring it in a straight line with the affected limb, and thus really abducts the limb not operated upon. By placing the patient in the splint with *both* limbs abducted, it is impossible for him to change his position without a great deal of discomfort to himself; therefore, we are sure of securing the desired abduction of the limb that was operated upon.

The patient is kept in bed in the dorsal position as quiet as is possible for from ten to fifteen days, when active motion is instituted to the limit he will tolerate. This consists at first in raising and lowering the limb as much as conditions will permit, and in attempting to flex the leg on the thigh, and the thigh on the abdomen. Passive motion is thus performed daily, and at the beginning of the second or third week, depending upon the progress of the case, lateral movements are begun, consisting of forcible abduction and adduction. The splint is allowed to remain on for about four or five weeks. It is removed when it is apparent that the patient has a fair degree of motion in the joint, without much pain or discomfort. He is then allowed to be up and around on crutches, and is encouraged to swing the limb in all directions, increasing motion in the joint by every means possible. The stitches are usually removed on the tenth or the twelfth day, and a fresh dressing is applied, minus the collodion. He is permitted to put weight on the limb about five weeks after the operation, and then urged to put the limb in abduction as far as is possible many hours each day.

ANCIENT TUBERCULOSIS OF HIP-JOINT—ARTHROPLASTY—TENOTOMY OF ADDUCTORS

Summary: Clinical history of patient; comments—sites of lodgment of B. tuberculosis in hip-joint according to age; resection *vs.* arthroplasty; operation—arthroplasty without resection of great trochanter; question of necrosis of flap-end; aspiration of hematoma; tenotomy of adductors; dressing; recapitulation.

CLINICAL HISTORY OF PATIENT

THE patient, a male twenty-three years of age, was admitted to Mercy Hospital September 29, 1915. The family and past histories are negative.

When three years of age, without any preceding trauma, a dull pain appeared in the left knee-joint. This pain increased in severity, and six months later pain started in the left hip-joint. Coincident with the onset of the pain in the knee the thigh began to flex until, eighteen months later, the thigh was flexed on the abdomen and the leg on the thigh, with the heel in contact with the buttock. The thigh could not be actively or passively extended. The knee was not stiff.

The pain in the hip became severer. A year after the beginning of the trouble an abscess formed in the hip, which abscess was lanced. The patient does not know whether or not he had chills or fever. The diagnosis of tuberculosis of the hip was made, and the patient was then taken to a hospital, anesthetized, and the limb was straightened. A gypsum case was applied to the hip and the limb maintained in the position of extension for two and one-half years. The abscess discharged for almost three years. When the patient was seven years of age, the extension-apparatus was removed, but he did not walk upon the limb until a year later. Between the ages of eight and fourteen he walked with the aid of crutches, and since then has worn an elevated shoe. At the present time there is no pain in the hip, and the patient feels perfectly well.

COMMENTS

Dr. Murphy (October 2, 1915): The history of this patient is a clean-cut one of primary tuberculosis of the hip-joint beginning in either the epiphysis or the synovial membrane. In children B. tuberculosis usually lodges first in the synovial membrane, while later in life it practically always involves first the epiphysis or neck of the femur (Fig. 16, p. 104).

This limb was previously adducted, but under ether the adduction was partially corrected. There remains a slight degree of adduction and flexion to an angle of about 40 degrees.

Today we intend performing either resection or arthroplasty. If, after exposure of the joint, we find an encapsulated focus of tuberculosis, we shall perform resection. In the hip-joint, in the presence of a focus of tuberculous *brie,* we do not perform arthroplasty, nor in any position in the presence of tuberculous pus, because we have learned that the result is not good, because of later bacterial destruction of the interposing flap. Owing to the short femoral neck this is not a favorable case for performing arthroplasty, such, for example, as is the ordinary joint ankylosed as the sequence of acute bacterial infection, in which the head of the bone is usually practically intact, though ankylosed.

OPERATION

[U-shaped incision made with center at great trochanter.]

Now I am elevating the fascia lata, exposing the margin of the gluteus maximus posteriorly, and part of the gluteus medius in front: in this case the fibers of the gluteus medius run somewhat contrary to the normal direction owing to the ascent of the great trochanter. [Incises and retracts gluteal muscles.] Here is the remnant of the capsule of the joint. [Reflects capsule.] There is the site of ankylosis, in the separation of which our difficulties begin. The head of the femur is slightly luxated posteriorly. [With curved chisel frees ankylosis; with end-mill reshapes head of femur, and with reamer restores acetabular cavity.] There is a fairly good conformation of the head of the femur and of the acetabulum.

Now I am preparing the interposing flap from the deep fascia. [Interposes flap in joint.] . . . . Now we are ready to place the head of the femur back into the acetabular cavity. The bones composing the joint cannot unite again, any more than a fracture could unite if soft tissue were caught between the ends of the fragments. [Controls hemorrhage by forcipressure and approximates incised gluteal muscles, subcutaneous tissues, and skin.]

Formerly, when we made the U-shaped flap longer than we make it now, there not infrequently resulted necrosis of the flap-end. With this short flap, however, we never see necrosis ensue, and it is unnecessary to make the flap longer. Occasionally a hematoma forms, requiring aspiration.

In order to secure abduction of the limb we shall have to tenotomize the adductor muscles. [Performs subcutaneous tenotomy of adductors.] . . . . Note the great subcutaneous depression that has resulted from tenotomy of the adductors. The limbs will be placed in a Rainey splint in the position of double abduction with extension and traction in order to prevent destruction of the interposed fat-fascia flap.

RECAPITULATION

Let the record show that the bony ankylosis exhibited by the skiagram was encountered; that there was practically no femoral neck; that the great trochanter had ascended upon the dorsum ilii; that, owing to the absorption of the femoral neck, we did not resect the great trochanter in the usual way, but retained it and divided the gluteal muscles on one side; that we utilized a mass of new hyperplastic bone to fashion a fairly well-shaped head which, brought up to the acetabular cavity, answered the purpose of a head very well; that we next reamed out the acetabulum and made a round, smooth cavity; that we then resected a portion of the bone from the upper part of the great trochanter, which impinged against the margin of the acetabulum; that we next applied the end-mill to the head and rounded it off in the usual way; that the interposing flap of fascia lata and fat was prepared and inserted into the acetabular cavity, and the head was replaced upon it without difficulty; that the divided gluteal muscles were then reattached to the great trochanter, and the cut edges of the gluteal aponeurosis, of the superficial fascia, and of the skin were sutured together without drainage; and finally that all the work was accomplished without hand-contacting.

Postscript.—The patient made an uneventful recovery, and the arthroplasty was in excellent condition at the time of discharge from hospital.

ANCIENT TUBERCULOSIS OF HIP-JOINT WITH PATHOLOGIC LUXATION OF FEMUR—TENOTOMY OF ADDUCTORS. TALK ON ORIGIN, NATURE, AND TREATMENT OF TUBERCULOUS *vs.* METASTATIC PYOGENIC JOINT-DISEASE

Summary: Clinical history of patient; examination by measurements; comments—nature and effects of the deformity; crime of devoting too much attention to rarer diseases and not enough to the commoner, such as joint tuberculosis; operation—tenotomy of adductors, with remarks upon avoidance of fracturing the femur in abducting the limb; talk on joint-diseases.

CLINICAL HISTORY OF PATIENT

The patient, a female thirty-three years of age, was admitted to Mercy Hospital June 5, 1915. One sister died of tuberculosis ten years previously.

When four and one-half years of age, while at school, the patient fell, injuring the left hip. She limped about for a few days, and some weeks later—she does not recall exactly how much later—fever appeared, and she became incapacitated for two or three months. No abscess formed, and no external signs of osteomyelitis appeared. For the next two or three years she went about on crutches.

When the patient was nine years of age, a physician applied weights and a splint to the limb. As the result of this treatment the improvement was marked, and later she got about without pain and without the development of ankylosis, but there was left remaining marked adduction deformity with internal rotation of the limb.

When fifteen years of age, the patient began osteopathic treatment and continued it for five years, with improvement in the range of motion of the joint. She has received no treatment for thirteen years, or since she was twenty years of age. There is now marked shortening with *ad*duction of the left lower limb. The patient has compensated for the shortening both by downward inclination of the pelvis on the affected side and by wearing an elevated shoe.

EXAMINATION

The limb, from the tibial malleolus to the anterior superior iliac spine, measures 29¾ inches; the right, 32½. There are 2¾ inches of actual shortening and 4½ inches of apparent shortening. The left thigh, from the great trochanter to the patella, measures 15 inches; the right, 17¾. From the tip of the tibial malleolus to the upper edge of the internal tuberosity of the tibia the distance is 14¾ inches on both sides, showing that all the shortening is in the thigh and none in the leg. The foot is rotated internally, and the entire *ad*ductor group of muscles is enormously contracted and shortened. The capsule, too, is contracted and shortened, and the range of motion in the hip-joint is greatly diminished. Rotation is limited because the head and a large part of the neck have been absorbed. There is no bony ankylosis (Fig. 15).

COMMENTS

Dr. Murphy (June 7, 1915): You note the diagnosis as written on the board: "*Ancient tuberculosis of the hip-joint with pathologic luxation of the femur.*" This means that the head of the femur is destroyed, and that a new articulation, in which the range of motion is fairly wide, has been formed. There is one great handicap, however: the limb is held fixed in the positions of *ad*duction and internal rotation. The patient is able to flex and extend but not *ab*duct the thigh.

Fixation of the limb in the position of *ad*duction is the most common deformity of tuberculous coxitis, and is due to the upward luxation of the cervical stump, the tense *ad*ductors acting as bow-strings and, contracting powerfully, causing further ascent of the cervix upon the dorsum ilii. The atrophy and absorption of the head of the femur have extended away back to the epiphyseal line, except at one small spot. The tuberculous process subsided long since, but the *ad*duction deformity is left remaining and brings the limb across the lower pelvic entrance. This *ad*duction deformity makes the limb appear 4½ inches shorter than its fellow, whereas in reality it is only 2¾ inches shorter.

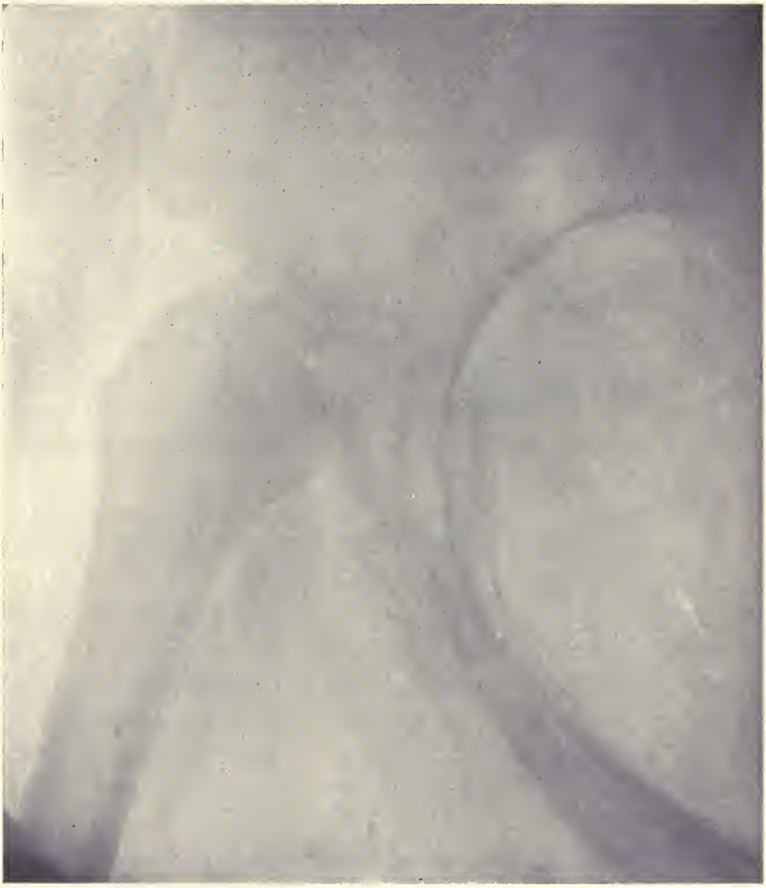

Fig. 15.—Pathologic luxation of caput femoris onto dorsum ilii. Head and large part of neck absorbed.

The prevention of this *ad*duction deformity is our obligation. Coxitis, tuberculous gonitis, and tuberculosis of the elbow are common, every-day diseases, and, like common crimes, receive but scant attention because they are so common. A new disease, seen once in ten years or once in thirty years, gets from 20 to 50 pages of space in journals or text-books, and the common crime of the mismanagement of these cases of joint-tuberculosis continues unchanged today, just as it was a third of a century ago; and, from a practical standpoint, so far as the prevention of deformity in tuberculous joint-disease is concerned, we have not improved one iota in our management of these cases, *i. e., the deformity at the joint is permitted to occur during the active stage of the disease.*

OPERATION

I must now endeavor to bring this limb around into the position of *ab*duction without fracturing it, and then slowly bring the pelvis, which is now inclined to the diseased side to compensate for the shortening, around to a position parallel with the horizon. As soon as I start to *ab*duct the limb you see it undergoing further internal rotation from the resistance of the entire *ad*ductor group of muscles, which has been shortened to the extent of 2½ inches. In order to bring the limb permanently into the position of *ab*duction, we must first divide the *ad*ductor tendons and then gradually stretch the remaining opposing muscles after the Lorenz plan. It may be necessary to divide the joint-capsule, in addition, but I think that it will not be.

As I *ab*duct the limb you can see the origins of these tense *ad*ductor muscles from the pubic spine, the descending ramus of the os pubis—straight on down along the ascending ramus of the ischium to its tuberosity—standing out prominently as salient, rounded cords. Once you get the tendinous portion of each muscle released and stretched, then you do not have much further difficulty. [Performs subcutaneous tenotomy of *ad*ductor group of muscles.] While stretching muscles that have been contracted for a long time we are in constant fear of exerting even a pound too much force and fracturing the femur, but by cutting a few fibers at a time and then stretching, the danger of fracturing the femur is minimized. [*Ab*ducts limb as muscles—one by one—are released.] See what a difference there is in this limb compared to the position it was in before! Note also the great subcutaneous depression that has appeared where these muscles were divided. As the muscles reunite, this depression will disappear. The tension now falls greatly upon the skin.

You will note that after these repeated efforts I have succeeded in abducting the limb to 70 degrees from the midline with the pelvis in a plumb position, and I have not fractured the femur. The limbs will now be dressed in a double gypsum case on the same basis that one treats a reduced congenital luxation of the hip. The limbs will be maintained in this position for ten weeks so as permanently to overcome the contraction of the abductor muscle group as well as the adductor deformity. Then the limb will be allowed gradually to come back to a straight position by a single-limb plaster case, which the patient is to wear for three months after she begins walking, so as to train her limbs to their new relationship.

Postscript.—There was but little reaction after the operation and the case progressed without untoward symptoms.

TALK ON THE ORIGIN, NATURE, AND TREATMENT OF TUBERCULOUS *vs.* METASTATIC PYOGENIC JOINT-DISEASE

The original lesion was situated on the upper surface of the head of the femur (Fig. 16, B) and began in the epiphyseal zone, because tuberculosis of bone practically always begins in the epiphysis, except in infancy and early childhood. Why does tuberculosis not begin in the epiphysis in infancy? It is because in their early stage epiphyses contain no bony tissue, consisting of cartilage alone, and tuberculosis never attacks cartilage primarily.

In infants primary tuberculosis develops in the synovial membrane. In childhood and adult life tuberculosis never involves the metaphysis or the diaphysis proper—at least not in this country. In Scotland, where children are fed upon milk and porridge, the bovine type of tuberculosis is active, and Mr. Harold Stiles, of Edinburgh, very frequently meets with cases of tuberculosis involving the *shaft*. In my own experience I have seen but two cases of tuberculosis involving the shaft.

Tuberculosis of bone involves the epiphysis just as characteristically and regularly as non-tuberculous bone-infections (osteomyelitis) involve the metaphysis, or end of the shaft. For example, metastatic pyogenic osteomyelitis practically never occurs in the epiphysis, but almost always involves the shaft side of the epiphysis (*i. e.*, the metaphysis), so that you know the nature of the lesion from the site in which it begins.

A SERIES OF TWO SKETCHES SHOWING INCEPTION AND PROGRESS OF COXALGIA

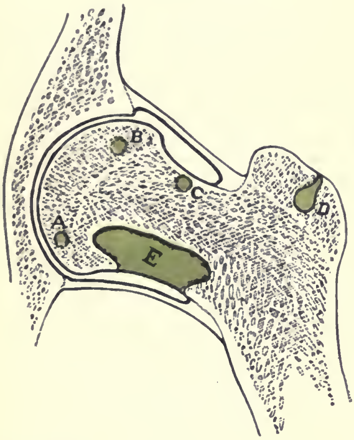

Fig. 16.—Primary osseous foci in coxalgia. Of foci A, B, C, E, the last is the first to rupture into synovial cavity, giving rise subsequently to condition depicted in next sketch. Focus D is in apophysis: secondary pyogenic infection at this site is liable to cause pyemia.

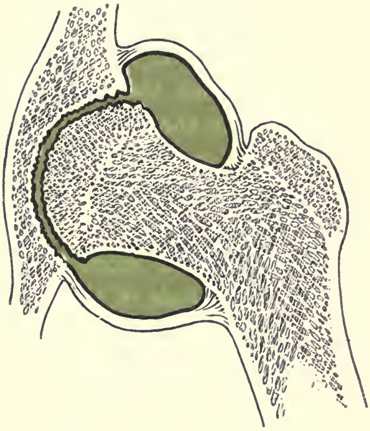

Fig. 17.—A later stage of coxalgia; tuberculous material free in joint-cavity, from primary synovial involvement or rupture of osseous focus into joint (E in preceding figure). Capsular bulgings indicate sites for injections. Roughening of articular surfaces of bones from pressure of contracting guard muscles, accounting for pain and showing necessity of fixation.

Why did this patient have pain? Because of the pressure of the cervical stump of the femur against the acetabulum from contraction of the muscles on guard. In tuberculosis of the hip-joint with increased intra-articular pressure from effusion (Fig. 17), the limb is at first often found in the position of *ab*duction, instead of *ad*duction, but in the majority of cases the limb is fixed more or less in *ad*duction from the very begining (Fig. 18, p. 111). But in other (pyogenic) types of metastatic arthritis the intra-articular pressure is reduced to a minimum when the limb is in the position of semiflexion and slight *ad*duction. This we have demonstrated on the cadaver by drilling through the great trochanter and driving a cannula into the joint, and then applying hydraulic pressure. We found that—even in the presence of cadaveric rigidity—when the pressure exceeded 120 mm. the limb assumed the position of semiflexion and slight *ad*duction, because when semiflexed the joint could accommodate the greatest quantity of fluid with the least degree of tension.

In an inflamed joint, contrasted to the single pressure within a phlegmon, *two* sources of pressure are operative: First, the pressure upon the articulating surfaces due to the contraction of the muscles on guard (Fig. 17); secondly, the increased intra-articular pressure due to the accumulation of the products of infection. Pressure from the first source is relieved by traction; pressure from the second, by aspiration.

In tuberculosis of the hip- or knee-joint, where the greatest degree of intra-articular pressure from muscular contraction is operative, the ambulatory splint *does not* relieve the intra-articular pressure due to muscular contraction: there is no ambulatory splint or gypsum case that is effectual in combating this pressure; in the case of the hip, the limb gradually becomes more and more *ad*ducted, despite the application of the ambulatory splint.

What is nature's method of healing first the tuberculous lesion, and secondly, the metastatic pyogenic arthritis—call it "rheumatism" if you like?

Tuberculosis always heals by cicatrization and encapsulation, by adhesion and fixation. If, in the early days of the tuberculous infection, bony ankylosis of the joint involved could be artificially induced by the injection of some irritating material, such as formalin, phenol, creosote, guaiacol, etc., the tuberculous process might heal, and then, later in life, with the process healed, the joint could be mobilized by performing arthroplasty. This patient's hip-joint did not become ankylosed, because the cervical stump of the femur underwent pathologic luxation upon the dorsum of the ilium, and through the periosteal interposition produced a movable joint, or pseudarthrosis, upon the dorsum ilii. The state of ankylosis is more desirable and less injurious than the ultimate destruction of the joint and luxation by the tuberculous process.

How should you treat cases of tuberculous arthritis of the hip? By an ambulatory splint? NEVER! *Put the patient to bed, and apply a double abduction travois splint, with the limbs in the position of extreme abduction, and Buck's extension-apparatus from above the knee on the diseased side so that if the head of the femur becomes absorbed by the tuberculous process, the neck merely goes farther into the acetabulum to take the position left vacant by the absorption of the head, and in this contingency, with the limb abducted, the cervical stump never can become displaced upon the dorsum of the ilium.* Such a displacement (Fig. 18, *1*, p. 111) is the worst of all evils consequent upon tuberculosis of the hip-joint. Next inject into the joint at this first dressing two drams of a solution, made up at least twenty-four hours previously, consisting of 1 per cent. formalin, 2 per cent. creosote, 2 per cent. guaiacol, and 95 per cent. glycerin. To this add 10 per cent. by weight of iodoform. This injection should be repeated every three weeks for three doses. This is the adult dose. Children should have from 40 minims up, depending on their age. The creosote and guaiacol combination was used very successfully by Calot. Next, have the patient—still in bed—taken out in the sun and open air every day (heliotherapy). Feed him and build him up day by day. Continue the treatment until the joint is healed even if it takes one, two, or three years.

With the limb in the position of *ab*duction and extension and with traction applied all sources of mechanical irritation are removed, the neck never becomes luxated upon the dorsum ilii, you will not have, as the result an *ad*duction-deformity, an apparent shortening of 4½ inches when the head and part of the neck alone are absorbed, and some day, if the joint has become ankylosed, you can establish a movable joint by performing arthroplasty. This treatment is an easy proposition, and can be applied to all your cases of tuberculosis of the hip. It will not only enormously diminish the period of invalidism, but also greatly improve the results we are getting in such cases.

The other type of joint lesion—metastatic pyogenic infection ("rheumatism")—nearly always is the result of infection from a primary focus somewhere else in the body. Unlike tuberculous infections, the metastatic pyogenic arthritides heal by phagocytosis.

The therapeutic indications are, then, first to relieve the increased intra-articular pressure from muscular contraction by applying traction to the limb in order to pull the articular ends of the bones apart, thus preventing contacting of these two inflamed surfaces. To obtain the necessary amount of traction in an adult, a weight of at least 35 pounds primarily is necessary. The second indication is to relieve the increased intra-articular pressure upon the joint-capsule and ligaments, due to the pus-products, by aspiration, lest the cartilage be destroyed and ankylosis result. The third indication is to aid the destruction of the microörganisms by injecting a germicide—such as formalin—into the joint. Just keep these two classes of bone-infection separated in your mind, first as to the method in which they destroy, and secondly, as to the method in which they repair.

Confusion is apt to arise because the orthopedist treats his cases of tuberculosis by immobilization, which, as he interprets it, is, in principle, the proper method. Then the general practitioner comes along, sees these tuberculous cases progress favorably under immobilization alone, and concludes that the proper thing to do is to immobilize the acute metastatic pyogenic arthritis cases as well. If the latter when severely infected be immobilized *without traction* for six, eight, ten, or twelve weeks, at the end of that time they will have become permanently immobilized by bony ankylosis in a deformed position—exactly what is to be expected from such misapplied treatment, and exactly what you do not want. See the point!

We have coming in here constantly, as we can show you by scores of pictures, so many cases of bony ankylosis following acute metastatic pyogenic arthritis, and with deformities of all sorts and contortions in all positions, because in the early hours or days of the disease the patient is permitted to lie with the limb in any position that gives him the greatest degree of relief; and if the joint infection be preceded by a chill, you can at once write across that patient's history sheet that he is going to have ankylosis of one or more joints.

To the medical practitioner who has charge of the case,—for it is usually in the early stage a medical practitioner's and not a surgeon's proposition,—the first day upon which the patient has the "rheumatism" instruction No. 1 is to put the limb in the most favorable position for subsequent usefulness of the limb, or for arthroplasty, in case it should become ankylosed. Instruction No. 2 is to apply traction in order to relieve the intra-articular pressure due to muscular contraction, and greatly to lessen the liability of ankylosis, thus relieving the *causative factor* of the pain by traction rather than the pain alone by hypodermic injections of anodynes.

ANCIENT TUBERCULOSIS OF HIP-JOINT—TENOTOMY OF ADDUCTORS

Summary: Clinical history of patient; comments—natural course of untreated tuberculosis of hip-joint; plan of treatment—ideal result at present time is ankylosis, with femur in acetabular cavity and abducted, and is obtained by immobilization in abduction for two and one-half years; in the future the treatment of tuberculosis of joints will be based upon producing early artificial ankylosis and performing arthroplasty when patient reaches maturity; operation—tenotomy of adductors; postoperative treatment—maintenance of limbs in double abduction by Rainey splint.

CLINICAL HISTORY OF PATIENT

The patient, a female nineteen years of age, was admitted to Mercy Hospital April 27, 1915. The family history reveals no tuberculous taint.

When five years of age in 1900, while jumping down a terrace the patient fell upon her left side with the left leg doubled under her. On getting up, so severe was the pain that she had to be carried home. In about an hour she was able to walk again, but the hip continued to ache for two months. Then a gypsum case was applied and the limb was immobilized for six weeks. When the case was removed she was able to walk without pain and went back to school.

A year and a half later the patient stumbled and fell, again striking upon the left side. The hip pained thereafter at intervals of every few days, but she was able to walk around. Massage and electric treatment were instituted, but without benefit.

Two years after the second fall the left hip began to suppurate. The abscess was opened in a hospital, and the wound discharged pus for two or three weeks, showing the presence of mixed infection. After the sinus had healed the patient wore a brace for one year and used crutches for three years, and since then has not walked without the support of a cane. There was no pain whatever for the next two years. After subsidence of the infection the limb was about three inches shorter than its fellow, and was not strong enough to bear its share of body weight.

Between the ages of fourteen and eighteen years the hip caused but little trouble, there being only an occasional pain.

In January, 1914, the limb again began to ache, and the pain increased until it became unendurable, and until the patient could walk no longer. Traction of 25 pounds was applied to the limb and retained for one month. Two injections of tuberculin were administered every week for two months. The patient was again able to be up and about.

Two months ago—in January, 1915—the pain again became unendurable. The patient again went to bed, and traction—this time of 30 pounds—was applied and maintained for three weeks. At the end of that time the patient got up and went about, but the traction was maintained by night. Pain has been present in the hip ever since. The general health is good; there has been no loss of weight.

The skiagram revealed total destruction of the head of the femur (Fig. 18).

COMMENTS

DR. MURPHY (May 3, 1915): That is a classic history with a classic result—the trauma, the development of tuberculosis, and the ineffective treatment, as shown by crippling of the patient for fifteen years, many inches of shortening, and the persistence of great pain. The primary lesion was in the head of the femur: what was done for it? Fixation was applied for five or six weeks, and thirteen years later traction; and tuberculin was administered for two months, after which the patient was prematurely allowed to be up and about. The disease cropped out anew, however, at various intervals. The treatment was inefficient in every way. It was too short in duration to permit the tuberculosis effectually to heal. It is a well-known fact that tuberculosis requires a much longer time than specified above to undergo repair. Mixed infection finally took place; the resulting abscess was opened and drained, and fortunately—though exceptionally with tuber-

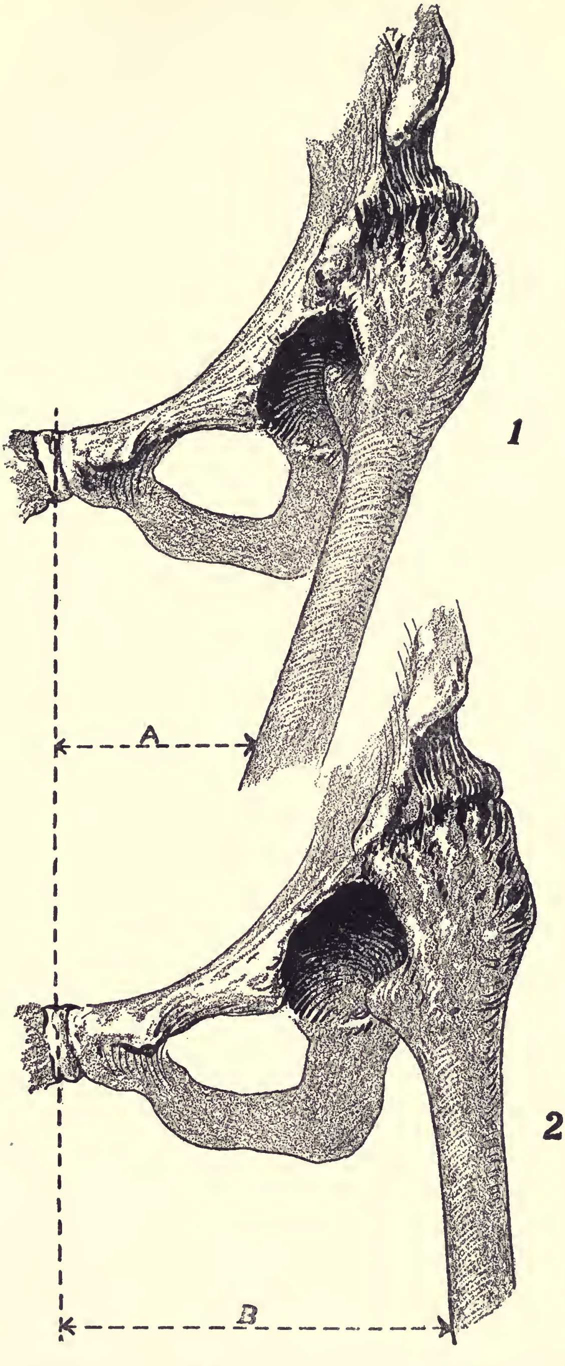

Fig. 18.—*1*, Result of unbridled coxalgia: Adductors contract (A); head of femur absorbs; neck slips over rim onto dorsum ilii and becomes fixed. The two causes of shortening are evident. *2*, Tenotomy of adductors releases femur to degree of abduction shown by comparing *B* with *A*. Interpreted skiagram sketches.

culosis—it did not leave a permanent sinus. Then the patient received a course of treatment with tuberculin for two months—the equivalent of no tuberculin treatment at all. This patient had recurrent attacks covering a period of fourteen years. Why? Because the original or recurrent attacks were not effectively treated.

How does tuberculosis destroy the upper end of the femur? By the process of absorption, which most commonly begins at the head and advances toward the neck, and at times into it. What position does the limb eventually assume? That of adduction with internal rotation, the great *ad*ductor group of muscles contracting in an endeavor to immobilize the inflamed joint (Fig. 18, *1*). Then what happens to the neck stump? It slips over the absorbed upper and back portion of the rim of the acetabulum and passes upward upon the dorsum of the ilium. Such is the usual result of mismanaged tuberculosis of the hip.

Joint tuberculosis differs entirely from all other types of arthritis in that it heals by cicatrization, instead of by phagocytosis.

Now what is the plan of treatment? The limbs should be fixed *early* in the position of double *ab*duction to the superlative degree (*i. e.*, until the top of the great trochanter approximates the rim of the acetabulum). Then as the head becomes absorbed the cervical stump left remaining cannot ride over the rim of the acetabulum upon the dorsum ilii, but must stay in the acetabular cavity. In tuberculosis of the hip-joint one of the best average results obtainable at present is bony ankylosis with the neck remaining in the acetabular cavity. Such a result is to be had by keeping the hip immobilized and *ab*ducted for two or two and a half years. If you get a stiff joint at all in tuberculosis, you get it by absolute immobilization for a long period of time, but always in the position of *ab*duction—never of *ad*duction.

In this case I am now working on an end result—with just as poor a result as one could possibly have, because the line of treatment that was carried out would never suffice to repair tuberculosis of the hip. The process of repair may be studied with the aid of the *x*-rays, but a long period of time is always necessary for the repair of tuberculosis.

Let me summarize our present treatment of tuberculosis of the hip-joint. Verify the diagnosis by a skiagram and the tuberculin test. Put the patient to bed with the hip immobilized and *both* hips *ab*ducted, with the extension applied as in previous cases, and intra-articular injections as above described; keep the patient in bed from one to two and one-half years. The bed should be on wheels, so that the patient can be wheeled out-of-doors into the sunshine and fresh air every day (heliotherapy). Ambulatory splints are failures in the treatment of tuberculosis. Tuberculin should be administered every week for one to one and one-half years, the dose to be governed by the reaction.

If you will look at the skiagram, you will see that the head of the femur is absorbed and that the acetabulum is obliterated. There is a mass of fibrous tissue above the acetabulum.

OPERATION

[Performs tenotomy of *ad*ductor muscles, as in previous case, gaining much *ab*duction of femur (Fig. 18, *2*).] Now we shall apply a double Rainey splint, by which the limbs will be maintained in the position of double *ab*duction. After a while the patient will be able to lower the pelvis on the affected side and bring the foot down upon the ground.

Postscript.—The reaction to the operation was *nil.* The case progressed without complications.

ANCIENT METASTATIC BACTERIAL SYNOVITIS OF HIP-JOINT WITH ADDUCTION-DEFORMITY—THREE-STAGE OPERATION: (1) TENOTOMY OF ADDUCTORS; (2) TENOTOMY OF ILIOPSOAS; (3) STRETCHING BY MANIPULATION

Summary: Clinical history of patient; examination; first operation—tenotomy of adductors; second operation—tenotomy of iliopoas; analysis of history; in tenotomy about hip followed by muscle-stretching be careful not to fracture femur; third operation—stretching of adductors by manipulation; postoperative comments.

CLINICAL HISTORY OF PATIENT

The patient, a married woman thirty-two years of age, was admitted to Mercy Hospital December 3, 1914. The family and past histories are negative.

When twelve years of age, while in an orphan's home, the patient scrubbed the floor one morning while in her bare feet, and the following night there began severe pain in the left knee. She does not recall having had chills or fever. During the next three days the pain was excruciating, and it finally became unendurable. Five days later she was found unconscious; she became delirious and remained so for three weeks. She was bedridden for three months, and then was able to be up and about on crutches.

Six or seven months later two abscesses appeared in the left hip, but no sequestrum formed. Next an abscess appeared in the right humerus, and a sequestrum was discharged. By the end of a year the abscesses were all healed.

Two years ago the patient was operated upon for right femoral hernia, and since the operation there has been some pain in the knee-joint upon walking.

Upon examination the right lower limb, from tip of tibial malleolus to anterior superior iliac spine, measures 31½ inches; the left measures the same. The shortening (four inches), therefore, is only an apparent shortening, and is due to the upward inclination of the pelvis upon the affected side. The patient wears a four-inch elevation on her shoe on the affected side.

FIRST OPERATION

[On December 7, 1914, Dr. Murphy performed tenotomy of the *ad*ductor group of tendons.]

SECOND OPERATION

DR. MURPHY (December 17, 1914): Ten days ago we performed tenotomy of the *ad*ductor muscles, and you will note as the result the present *ab*ducted position of the femur as revealed by the skiagram, which shows also lipping about the acetabulum.

The story, in brief, is that after exposure in the morning, by night-time there was pain in the left knee, and when the patient moved about the whole limb pained. About six months later abscesses appeared in the left hip and in the right humerus. The disease was one of the acute infections of the femur or hip-joint, and not tuberculosis, because tuberculosis never incapacitates the patient in one day; the secondary infection in the humerus also shows that it was not tuberculous. There were 4½ inches of *apparent* shortening, but there is practically but 1 inch left remaining now, after the operation of two weeks ago.

[Stretches *ad*ductor muscles still further.] I am now able to *ab*duct the limb to the superlative degree. I must release the contracted iliopsoas muscle as well, by dividing it just above its insertion into the lesser trochanter of the femur. In performing tenotomy about the hip and forcing correction of position when stretching the muscles you must always be very careful, because the femur is easily fractured and breaks almost like a pipe-stem, if you get the leverage to bear from an unfavorable direction. After tenotomy, stretch the muscles according to the Lorenz scheme, progressing a little further at each pressure effort until you finally succeed in getting the desired result. Now you see what a great degree of *ab*duction we have been able to attain: it is easily 50 per cent. more than it was before. The remaining inch of apparent shortening has been overcome.

Let the record show that the patient can now *ab*duct this limb to the normal extent without great tension.

Every acute inflammation, every fracture, and every tuberculosis of the hip must be dressed primarily in the position of *ab*duction, and kept there all the time until healing is complete. The prophylaxis of this deformity is the ideal to which we should aspire and we can readily attain it.

THIRD OPERATION

Dr. Murphy (September 16, 1915): What we want to do today is to get the limb into the position of complete *ab*duction. There is now only one-half inch of apparent shortening. The patient uses a cane and walks as though there were two inches of shortening. If we can overcome the remaining slight degree of *ad*duction without fracturing the femur, she will walk as though there were only one-half inch of apparent shortening; and then, as she overcomes the inclination of the pelvis toward the affected side, she will walk as though there were *no* shortening. There is a depression left remaining over the site of the tenotomized muscles.

I am now stretching the remaining tissues. [Manipulates hip until the slight *ad*duction-deformity is overcome.] The Rainey double *ab*duction splint will be applied. As a sequence of these three operations of tenotomy and stretching we are going to obtain a splendid result.

POSTOPERATIVE COMMENTS

When this trouble began in the hip-joint, all that girl needed was to have some one apply Buck's extension-apparatus to the leg, extending up to the thigh, and then dress the limbs in the position of double *ab*duction. Such treatment would have prevented the *ad*duction of the limb that ensued, and kept the head from slipping out of the acetabulum. When the thigh is doubly *ab*ducted, it is practically impossible for the stump of the cervix to slip out of the acetabular cavity.

In this patient part of the acetabulum also has been absorbed, but not too extensively to prevent the head from making that degree of rotation which is essential so that she can walk with full power of *ab*duction. With the thigh *ad*ducted to the extent it was in the beginning, she could not have been delivered of a child; but now with the pelvis open she is able to enter upon the state of child-bearing. If the ankylosis had been bony in type, we would have performed arthroplasty. In this case there is no occasion to perform arthroplasty, because there is already a good range of flexion and extension.

We dress all hip-cases in the position of double *ab*duction. There you see the type of splint we use: we call it the Rainey splint, and with a saw you can make one from a piece of fence-board in twenty minutes.

Postscript.—Excellent restoration of motion and freedom from apparent shortening resulted.

There is an enormous untilled field for work in this class of poor or bad end results from various diseases at the hip-, shoulder-, elbow-, and knee-joints, and it behooves the profession to give these patients the advantages so easily and safely available for their relief.

OSTEOMYELITIS OF FEMUR—SEQUESTRECTOMY (TWO CASES)

Summary: Clinical history of patient; comments—magnitude of involvement of femur; history characteristic of osteomyelitis; operation—sequestrum exposure and removal; a common source of error in performing sequestrectomy; recapitulation; postoperative comments—history classic; importance of drilling bone on first day of infection of its medulla; length of time required for involucrum to regenerate shaft of femur.

CLINICAL HISTORY OF PATIENT

The patient, a male sixteen years of age, was admitted to Mercy Hospital April 26, 1915. The family and past histories are negative.

Three and one-half months ago, on January 10, 1915, while out skating, the patient overexerted himself and then participated in a snow-ball fight, which seemed to tire him out. On arriving home he went immediately to bed. He went to school the next morning, but felt drowsy; and on returning home did not eat any dinner, because of loss of appetite and feeling tired.

The next day the patient went back to school, but came home early, suffering from a headache. On getting up the next morning the right thigh felt sore and ached; and although he went to school, when he came home he could hardly walk on the limb. He again felt tired and went to bed, remaining there nine days. There was fever of from 102° to 103° F.; chills were absent. A physician diagnosed the malady as "rheumatism." During the nine days' stay in bed the thigh was swollen and red and ached considerably.

At operation, twelve days after the onset of the bone-infection, on January 22, 1915, about a cupful of pus was evacuated from the thigh. A rubber drainage-tube was inserted and left in for nine days. After the operation the pain disappeared and the swelling subsided, but since the operation the patient has been unable to put weight on the limb. A sinus is left remaining, from which pus has been constantly discharged.

COMMENTS

Dr. Murphy (April 28, 1915): This patient's thigh presents one of the most extensive degrees of destruction of the shaft of the femur that we have seen: it looks as though the femur were infected practically its entire length. From the history we know that the disease was osteomyelitis—an infection in the medulla of the femur, extending away up almost to the great trochanter. The entire shaft forms a sequestrum and is inclosed by a thin involucrum.

OPERATION

[Makes lateral intermuscular incision for exposure of shaft of femur.] . . . So far as I have exposed the bone the disease involves the length of the shaft of the femur. See the poolings of pus! No wonder the patient has been sick, from so much pus in the thigh for such a long time.

The cloacæ lead from the sequestrum to the surface. The shaft for its entire length forms one huge sequestrum, and I must first split it before being able to remove it. The involucrum forms a mere shell of bone around the entire sequestrum. [Splits sequestrum.] . . . The sequestrum has a very offensive odor. It is when removing the distal portion of the sequestrum that the fault lies in performing sequestrectomy: you curette and think that you have reached the bone on the opposite side, when in reality you are still dealing with the dead shaft. The complete removal of the sequestrum is rarely accomplished, if one is to judge from the number of cases that come in for reoperation. [Inverts muscle-tissue from vastus externus into resulting cavity, fixes it there, and closes wound.]

RECAPITULATION

That was a beautiful history—classic in its clinical course, which led to a diagnosis, and classic in the errors that were made in its early treatment. There was only one measure that would have saved the femur from necrosis—the drilling of a hole in the bone with an ordinary gimlet (Fig. 25, *2*, p. 173) and evacuating the pus on the first day the patient complained of the aching in the thigh: had that been done, we would not have had to take out this sequestrum, for there would not have been a sequestrum. Such a lesson is harder to learn than the lesson of early operation in acute appendicitis. It is like a fire: unless the alarm be responded to promptly, there is no use of sending the fire-apparatus at all.

The cavity left remaining in the femur today after removal of the sequestrum will probably be entirely filled in by the end of eight or nine months.

Postscript.—The case progressed without untoward symptoms after the operation.

II

Summary: Clinical history of patient; comments—history classic; prompt diagnosis of osteomyelitis as easy as that of acute appendicitis and of equal importance; how osteomyelitis destroys shaft of a bone; deep, but no superficial, local tenderness in osteomyelitis; operation—extent of destruction; avoidance of operative injury to epiphyseal line; eburnated bone in medullary cavity; sequestrum removed; wound closed.

CLINICAL HISTORY OF PATIENT

The patient, a female thirteen years of age, was admitted to Mercy Hospital April 28, 1915. The family history is negative. Six years ago, when seven years of age, the patient suffered from an attack of pneumonia.

Nearly two years ago, on June 2, 1913, the patient was afflicted with a severe headache which lasted two days. There were no chills, nor was there any fever, and she did not vomit. During the succeeding two days she felt tired out and weak, and on the third day was out in the rain. In the evening of the third day pain appeared in the lower portion of the thigh, and the following morning the thigh began to swell, and there was fever of from 101° to 103° F. A physician diagnosed "rheumatism" and prescribed medicine, ordered her to bed for seven weeks, and had the limb rubbed with liniment. The limb remained swollen and painful, however, and the fever continued throughout the period of confinement to bed. By the end of seven weeks the fever had disappeared and the patient got up, but the limb continued to ache—though intermittently—by night and at times by day.

During the next three weeks the patient could not walk upon the limb, owing to the weakness and pain which arose when weight was put on it. From that time until January 1, 1915, she was up and about, walking on the limb, but the swelling of the limb never entirely subsided, and the limb ached periodically about every two weeks. Following her physician's advice she did not go to school for a year.

Four months ago, on January 1, 1915, the left thigh became red on the inner side, above the knee, and began to ache. The patient took to bed for two days. There was fever of 101° F., unaccompanied by chills. At the end of that period she got about, the leg aching at times and remaining red. During the next three weeks clay poultices were applied, the abscess in the thigh pointed and discharged about one ounce of pus, and thereafter about one-half ounce daily, with relief of the pain and subsidence of the fever.

COMMENTS

DR. MURPHY (April 29, 1915): The history is classic for osteomyelitis—classic even in the diagnosis of "rheumatism." The readers of the CLINICS must think that we are short of material, to put in one or more cases of acute infective osteomyelitis that have been diagnosed as "rheumatism." Recall the patient upon whom I operated yesterday (*vide supra*), removing a seven- or eight-inch sequestrum from the femur: such extreme pathology is avoidable, and easily avoidable.

It is just as easy to diagnose acute infective osteomyelitis in the first eight, ten, twelve, or twenty-four hours as it is to diagnose the average case of acute appendicitis. After making the diagnosis, what's the idea in waiting any longer? Every moment that you wait after having made the diagnosis means another moment of destruction or injury to the patient (Figs. 25 to 28, p. 173). When you make the diagnosis you know that you have pus in the medulla confined in a bony wall; that it cannot readily escape; and that it is going to destroy the bone unless something be done to evacuate it. The moment you make the diagnosis you should cut down upon the bone where it is sensitive to deep, not to superficial, pressure.

In osteomyelitis there is no sensitiveness to superficial pressure *in the early hours of disease*, but if you put the thumb or fingers on the place where the patient complains of the pain and press deeply for ten, fifteen, or twenty seconds, the pain becomes intolerable. When you cut down upon the periosteum over the infected area, it will be found edematous and show a peculiar myxoid appearance. Then, with an ordinary gimlet, drill a hole clean into the medulla and evacuate the pus—"vent" the abscess like the dentist does when the toothache patient is clamoring for relief.

This case is not nearly so wicked in nature as yesterday's case was.

OPERATION

[Intermuscular incision made on outer side of thigh.] . . . Note that spot about two inches in diameter just above the epiphyseal line: it indicates the involved area, and the sinus leading from it has been discharging continually. [Manipulates probe in sinus.] . . . . That probe enters near Hunter's canal and traverses cicatricial granulation tissue all the way up to the canal. The abscess has gravitated into the popliteal space, which is a very common site for a thigh-sinus to open.

Judging from external appearances, no one would think that there was such an extensive involvement of the bone as we see here. Most of the pathology is located about two inches above the epiphyseal line, and since it does not involve the epiphysis, I wish to avoid encroaching upon the epiphyseal line.

In place of the medullary cavity being patent and containing marrow, it is filled in with eburnated bone from the chronic inflammatory condition, corresponding exactly with the appearance presented by the skiagram. See that drop of pus, that little white pearl? It leads from the pocket of suppuration around the central focus, which should contain a sequestrum. [Explores for, finds, and removes sequestrum.] . . . . . Now we shall mop the cavity out with 5 per cent. phenol. . . . I am freeing a mass of the vastus externus muscle so as to insert it into the bone-cavity and fix it there with periosteal sutures. The implantation of a pedicled muscle, fat, and fascia flap is a very important factor in diminishing the length of convalescence from these conditions. When the cavity in a bone is large, and particularly in patients beyond middle life, it often requires months and even years for it to fill. If one can insert the end of a pedicled flap and retain it in the bone-cavity until it unites, it rapidly grows to fill the space and hastens the process of repair.

Postscript.—The case progressed without complications.

TRAUMATIC RUPTURE OF INTERNAL LATERAL LIGAMENT OF KNEE-JOINT—SYNDESMORRHAPHY. TALK ON CERTAIN INJURIES WITHIN AND ABOUT THE KNEE-JOINT

Summary: Clinical history of patient; examination; comments—proper time to operate upon bone-fractures or joint-injuries, with reasons; comparison of infection-resisting properties of serous membranes; operation—suture of ruptured ligament; postoperative treatment. Talk on certain injuries within and about the knee-joint.

CLINICAL HISTORY OF PATIENT

THE patient, a male fifty years of age, was admitted to Mercy Hospital September 1, 1915. The family and past histories are negative.

Three days previously, on August 29, 1915, while guiding a wagon by its tongue as it was being backed into a shed, the end of the wagon-tongue struck upon the outer side of the right knee, throwing the patient a distance of seven or eight feet. He landed upon a few timbers, where he found himself sitting up with the right thigh drawn up and the leg turned outward. There was much pain. He did not lose consciousness. He was brought to hospital with the leg flexed and abducted, and the patella subluxated externally over the external condyle of the femur. The subluxation of the patella was reduced by manipulation, and the leg was placed in a wire splint. The pain has diminished since admission to hospital.

Examination by Dr. Murphy (September 3, 1915).—There is no fracture of either the femur or patella. The internal lateral ligament is torn. The leg can be abducted at the knee-joint without abducting the thigh, and when abducted, a depression appears on the inner side of the knee (Fig. 19, *A*). The nature of this injury corresponds with his story, that the tongue of the wagon struck him upon the outer side of the knee, and that when the knee was bent inward, the patella slipped to the outer side.

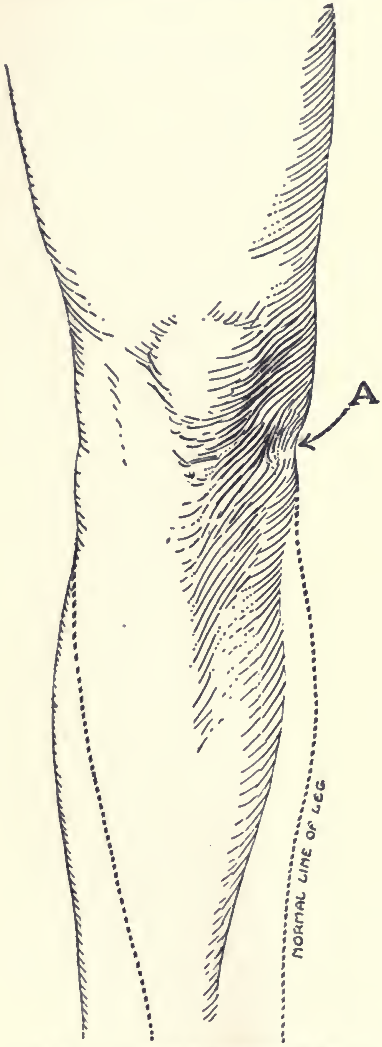

Fig. 19.—Surface-depression from rupture of internal lateral ligament at A. Gauge extent of preternatural abduction-mobility by double contour of leg.

COMMENTS

Dr. Murphy (September 8, 1915): The accident happened on the twenty-ninth of August—ten days ago. This is the usual time we operate upon bone-fractures or joint-injuries. We never operate immediately, but give the tissues a chance to coffer-dam themselves by reaction-infiltration, and thus increase their powers of resistance against infection, which might be introduced at operation.

When I saw this patient last week there was in the knee-joint an enormous effusion, which by now has practically all disappeared. If you operate upon a normal knee—one that has not been subjected to trauma, and thus one that has not been prepared by lymph-space coffer-damming beforehand—the next day there will be considerable effusion from operative traumatic synovitis. On the other hand, after operating today upon this already coffer-dammed knee, if I should open it again—say tomorrow—and examine it, I would find that there was practically no effusion,—a sign that the superlative degree of resistance against infection had been attained, seeing that an effusion acts as a culture-medium for bacteria.

In human serous tissues superlative resistance to infection is expressed in the peritoneum; comparative resistance in the pleura; positive, in the joint synovial membrane; and minimum resistance in the meninges. Thus it comes about that it requires but a small number of microörganisms to start up infection in the meninges; it requires more to start up infection in a joint; a still greater number to infect the pleura; and it requires the greatest number to infect the peritoneum. If you know the reason for postponing operation, then it is easy to delay; but if you have merely the dogmatic statement of a surgeon, you conclude that it is just his system.

OPERATION

Before proceeding with the work we shall cover that traumatic aseptic ulcer completely with collodion. The line of incision will be some little distance below the position that ulcer occupies. See the depression on the inner side! There is the ruptured internal lateral ligament: with the retinaculum it is torn across from its anterior border at the ligamentum patellæ clear back to its posterior (Fig. 20). Its torn edges are turned in, preventing healing of the ligament: with failure of union this man would have been completely incapacitated, were he not operated upon. The conditions found here are comparable to those encountered in many cases of fracture of the patella. [Unites torn edges of internal lateral ligament with chromicized catgut; closes wound.]

RECAPITULATION

Let the record show that the internal lateral ligament was found ruptured transversely; that the edges were turned in (entropion); that after everting the edges until they faced each other we apposed and fixed them with No. 2 through-and-through chromicized catgut sutures; that we shortened the internal portion of the joint-capsule; and finally that the leg will be dressed in the position of adduction, in order to relieve the freshly sutured ligament of tension.

Let the record show further that we succeeded in performing this work all without hand-contacting, and that the scalpel was changed as soon as the skin was divided.

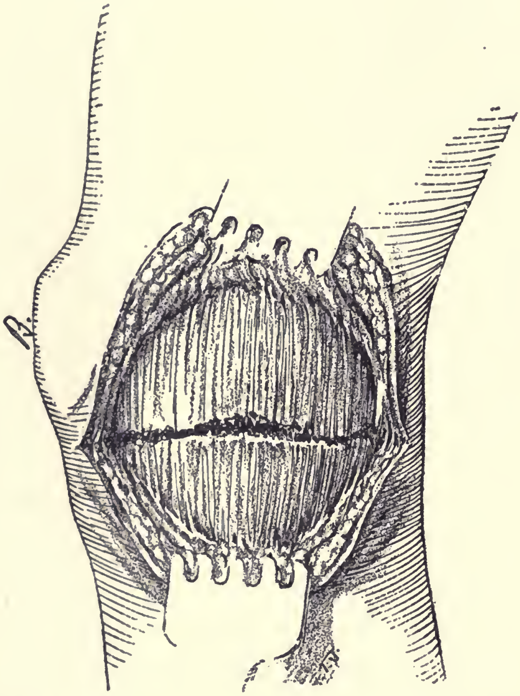

Fig. 20.—Edges of rent found turned in, rendering firm union without operation impossible. *B* is over center of patella.

POSTOPERATIVE TREATMENT

The limb is placed in a wire-gauze splint and kept in the splint for twelve days, when the stitches will be removed. Then a gypsum case will be applied to the limb. It takes a little longer for ligaments to unite than for bone. After removal of the first gypsum case a somewhat lighter case will be applied and will be worn for six weeks. When we are assured of complete union of the ligaments, the patient will be permitted to get about.

POSTOPERATIVE COMMENTS

Writing on the "Surgery of Articular Ligaments," Kocher ("Text-Book of Operative Surgery," 1914, 275) says: "We would merely observe in connection with the ligaments that the treatment especially of traumatic lesions of joints should be much more active than it is at the present time. A large number of cases of so-called chronic arthritis might be prevented were the torn ligaments promptly sutured. . . . Ligaments heal comparatively well. . . . Suture is a means to this end, if one knows how to open into the joint without causing damage to its function."

In reporting two cases of traumatic rupture of the internal lateral ligament of the knee-joint Phillips (*Surg., Gynec. and Obstet.*, December, 1914, 729–733) states: "The disability arising from a rupture of the ligaments of the knee is very serious and lasting. This is apparent on anatomic grounds. . . . When the ligaments do give way, as in rupture or sprain-fracture, the length of the ligaments predisposes to a wide separation of the broken ends (hence, to a slow and insecure repair), while the length of leverage and weight to be borne necessitate great strength to withstand the strain. Taking these facts into consideration, is it any wonder that we find so many braces worn to assist an injured knee in performing its functions?

"When the internal lateral ligament is ruptured, it may be reinforced by superimposing the tendon of the gracilis muscle upon it (Fig. 21).

"In treating a ruptured ligament there is usually no endeavor at all made to approximate the torn ends of the ligament."

Phillips concludes with the statement: "I believe we have been entirely too conservative in our treatment of severe sprains, and that we should be as ready to repair a ruptured ligament as to mend a broken bone."

Postscript.—Healing *per primam.* No effusion into the joint followed operation.

TALK ON CERTAIN INJURIES WITHIN AND ABOUT THE KNEE-JOINT

In many cases the veil of mystery is never lifted to disclose these injuries, and they are treated as "sprains" or as contusions, and the patients are doomed to years of avoidable crippling, because of errors in diagnosis or ill-directed treatment. A contusion means that nothing has been ruptured, nothing broken, nothing displaced. A "sprain" is only too often a term that is misused, just as is the term neuralgia or lumbago—that is, as a convenient way of disposing of a case or of fulfiling the obligation of having to give a name to a lesion that sounds plausible to the patient. To my mind, far from being the easiest, sprains and contusions are the hardest diagnoses to make, since they can be justly arrived at by processes of exclusion alone—that is, after every other likely lesion has been considered and rejected. Too often the pathology of knee-trauma is considered to embrace, if not a gross fracture, then a "sprain" or contusion, and the intermediate conditions are either unknown or, if known, not looked for.

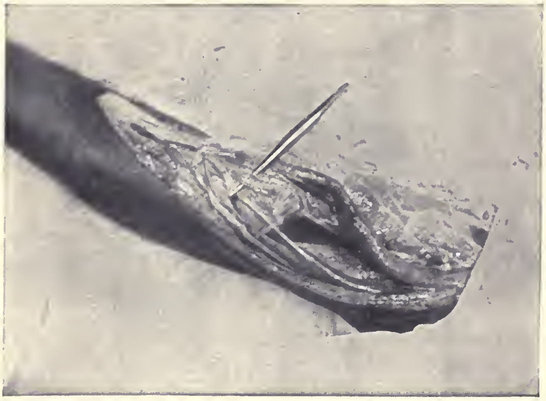

Fig. 21.—Reinforcement of ruptured internal lateral ligament by superimposing tendon of gracilis upon it (Phillips).

What are these intermediate conditions? Between the extremes of a fulminating lesion, such as a gross fracture and a mere contusion, there may be: Injury to the bones, as a fissured fracture of one of the condyles of the femur, or of one of the tuberosities of the tibia, or separation of one of the tubercles of the tibial spine, or tear-fracture of the femur, tibia, or patella, or separation of the tubercle of the tibia (Schlatter's deformity); bruising of the synovial membrane or of the articular cartilage, or tear, fracture, or luxation of the semilunar cartilages; luxation of the patella; and, finally, a "sprain," the pathology of which should be visualized either as an intrinsic rupture, as in the case described above, or else as an avulsion from its osseous attachment (including a few granules or a definite shell of cortex) of one or more of the following ligaments: the crucial, the alar, the capsular, the lateral, or the ligamentum patellæ. In a paper entitled "Sprains and Strains of the Knee-joint," Cheattle (*The Practitioner*, 1914, xcii, 351) outlines the subject as follows:

"As to the ligaments, lateral mobility indicates a general stretching or rupture, and is a serious sign. External rotation of the tibia indicates rupture or stretching of the two lateral ligaments, because their joint action limits external rotation. The quadriceps tendon may be torn transversely above the patella, or the ligamentum patellæ may be ruptured. In either case there is inability to extend the leg. As to the crucial ligaments, if it is possible to move the tibia forward, without being kept in contact with the articular surface of the femur, the anterior has been ruptured or stretched or has torn away bone; if backward, the posterior; while if it is possible to rotate the tibia internally, both crucial ligaments have been damaged."

Robert Jones, of Liverpool, has this to say in reference to the treatment of ruptured ligaments of the knee-joint:*

"The rupture of any of the ligaments of the knee should be treated by absolute rest until healing is complete. We know that four or five weeks are essential to their repair, and that any elongation or laxity allowed to remain means functional disability. We know, furthermore, that for the accurate repair of tendon or ligament no strain should be thrown upon them during the period of healing. *Nothing but temporary stiffness follows*

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* See also article by same author on "Internal Derangements of the Knee," *Surg., Gynec. and Obstet.*, October, 1914, 427.

even prolonged rest. We would have but few recurring displacements of the semilunars if the first injury were efficiently treated by resting the injured structures, more particularly the internal lateral ligament."

My interpretation of knee-joint injuries is that, from a consideration of the importance of the knee-joint in supporting the weight of the body, as well as of the fact that ligaments are composed of dense fibrous tissue with but slight vascularity, the conclusion must be drawn that, unless operation be indicated, it is more logical to secure physiologic rest by immobilization, for five to seven weeks, depending on the age of the patient, remembering that it requires a longer period of time in a patient of the same age for a ligament to unite than it does for a bone.

Another intermediate injury to the knee, and one that frequently escapes recognition, is that of rupture of the crucial ligaments, as well as fractures of the spine of the tibia. This ground has been well covered in a paper by Jones and Smith (*Brit. Jour. of Surg.*, 1913, i, 70) and by Corner in his address before the A. S. A., 1913. Bearing in mind the attachments of the crucial ligaments, the important points to remember about their mechanism are:

"1. The anterior crucial ligament is tense when the knee is fully extended, and prevents the tibia from being displaced forward on the femur.

"2. The posterior crucial ligament is tense in complete flexion, and prevents the tibia from being displaced backward on the femur.

"3. Both ligaments check inward rotation of the tibia.

"Hence if, after an injury to the knee, the tibia can be displaced backward or forward or rotated inward in the extended position, an injury of one or both crucial ligaments may be diagnosed. To cause rupture of both crucial ligaments extreme violence is necessary—such violence, indeed, as would produce complete dislocation of the knee-joint.

"As to treatment, in case of recent rupture of one or both crucials, fixation of the knee for a period of from three to six months offers the best chance of recovery, and immediate operation should not be resorted to. In neglected cases, where movement has been allowed early, fixation of the joint should first be tried. This fixation should be continuous. Where pain, disability, and recurring effusions occur, the choice lies between an operation for suturing the crucials, a mechanical support allowing flexion, and arthrodesis. If the choice be in favor of suture, the capsule and ligaments should be made tense by reefing and stretching. It would be unreasonable to expect imperfectly repaired crucials to bear the great leverage to which they would be subjected in the presence of a lax capsule and lateral ligament.

"As to fracture of the spine of the tibia, the most constant sign is an obstruction in full extension. The block feels like a definite bony obstruction, and is quite different from the locking which occurs when a dislocated semilunar cartilage is nipped. There may be—

"1. Avulsion of the tibial spine or its internal tubercle.

"2. Fracture of the external tubercle of the spine.

"3. Injury to the spine, combined with fracture of a tuberosity of the tibia.

"As to treatment, if met with at once, the knee should be manipulated until full extension is secured. If there be no sign of laxity of the joint due to injury to the crucials or other ligaments, the fixation need not exceed two months. Good function may be confidently expected, in the absence of a bone block, to full extension. When full extension is not possible and disability exists in addition, whether it be pain, stiffness, or effusion, operation is to be recommended."

Jones and Smith have seen 17 cases of injury to the spine of the tibia within three years.

Another injury to the knee that must be considered, particularly in children, is traumatic separation of the tubercle of the tibia, also known as "Rugby knee" and as "Schlatter's disease," it having been brought forth by Schlatter in 1903 (*Beitr. z. klin. Chir.*, 1903, xxxviii). Sir James Paget described the condition in his essay on osteoperiostitis following sprain. A case has been reported and the literature reviewed recently by Corben (*The Practitioner*, 1914, xcii, 591). It occurs usually between the ages of thirteen and sixteen, and more commonly in boys than in girls. The cause is usually indirect violence, from sudden and violent action of the quadriceps extensor muscle.

"The symptoms are sudden pain in the front of the knee, temporary loss of power, and occasionally swelling and effusion into the joint, which may be so severe that the condition is mistaken for fractured patella. The symptoms may be so slight that medical advice is not sought for weeks or months, the condition being put down to sprain or growing pains. On examination, tenderness on pressure over the affected tubercle is practically constant. Not infrequently both knees are affected. As a rule, the displacement of the tubercle is very slight. Crepitus is rarely felt. The diagnosis is decided by a skiagram taken laterally, in which the tubercle is seen separated from the tibia.

"The treatment consists of rest and strapping the knee; the requisite length of time varies from a month up to a year or longer. Complete cure can with confidence be promised, with, of course, enlarged tibial tubercle."

EXTERNAL LUXATION OF PATELLA WITH A FOREIGN BODY IN KNEE-JOINT—REMOVAL OF FOREIGN BODY—IMBRICATION OF VASTUS INTERNUS APONEUROSIS

Summary: Clinical history of patient; comments—diagnosis made from history, which is classic and typical in these cases; differential diagnosis from luxation of semilunar cartilage; outline of imbrication operation; operation—removal of foreign body; imbrication of vastus internus aponeurosis; recapitulation.

CLINICAL HISTORY OF PATIENT

THE patient, a female twenty-one years of age, was admitted to Mercy Hospital May 28, 1915. The family and past histories are negative.

Nearly six years ago, in November, 1909, while lying on the floor, some one pulled the patient's leg, and she felt something snap out of position, and then spring back. The ensuing pain was intense for a few minutes, but she was able to use the limb the next day.

During the next five years, whenever the patient made a misstep, with the leg in a certain position which she cannot accurately describe, the knee gave way from under her, and every time that that happened she fell to the ground. She was always able to get up and walk, however, and the resulting pain lasted but a few minutes. The joint has never become locked.

Five months ago, in December, 1914, a slight swelling appeared for the first time. A gypsum case was applied to the limb and retained throughout the month of April, 1915.

At present there is dull pain in the joint and the patient walks with limitation of motion.

Examination by Dr. Murphy.—I am able to luxate the patella laterally until it rests upon the external condyle of the femur, to the outer side of the external ridge of the patellar fossa. There is also a foreign body beneath the ligamentum patellæ, which can be displaced upward. The joint is free from effusion.

COMMENTS

DR. MURPHY (May 29, 1915): Why did the patient fall to the floor?

INTERN: She fell to the floor because the knee gave way.

DR. MURPHY: Yes: it was just that expression that led me to make the diagnosis of luxation of the patella. She said that when she turned in a certain manner *she felt something give way, fell, and then felt slight pain in her knee*, which disappeared when she straightened it out. The history is quite different from that in luxation of a semilunar cartilage which, when luxated, gives rise to intense pain, and occasionally the patient falls to the ground on account of the intensity of the pain. This patient, however, did not fall to the floor because of severe pain, but because something gave way. When the loosened patella reaches a certain point it begins to mount up on the external ridge of the patellar fossa, and the patient is unable to support herself upon that knee, for there was no pulley-support left by which she could maintain herself erect. There is, in addition, a loose cartilage—not a loose semilunar cartilage, but a floating cartilage under the ligamentum patellæ The history is classic and typical of recurrent luxated patella.

I remember my first case of luxated patella. The patient was the wife of an army officer who was stationed at Yellowstone Park. She had been all around in an endeavor to find out what was the matter with her knee On palpating the patella I found that I could push it away to the outer side. I then brought her leg a little nearer the side of the examining table, diverting her attention from the knee all the time. Finally, when the leg reached the edge of the table I let it drop suddenly. She screamed, "*There is that pain!*" No previous examiner had ever seen the patella displaced, because the moment the patient straightened the leg the patella went back into its normal position. I demonstrated that test to the class at the time of performing the operation. She suffered from recurrent external luxation of the patella, which first mounted upon the outer ridge of the patellar fossa and then descended upon its outer side.

What is the plan of operative procedure for luxation of the patella? The technic consists in shortening the fibrous capsule on the inner side of the joint: but for the presence of the foreign body this shortening would be executed without opening the joint at all. This is the first case of acquired luxation of the patella treated by the imbrication operation in which we have found it necessary to open the joint. In this operation not only must you shorten the fibrous capsule on the inner side, but you must shorten also the insertion of the vastus internus aponeurosis, so that the patella will no longer be able to mount upon the outer ridge of the patellar fossa. You do not have to shorten the quadriceps aponeurosis in the patellar zone so much as in its internal lateral zone—all the work is performed upon the inner side of the patella, the imbrication involving the vastus internus aponeurosis alone. I am afraid of displacing the floating cartilage, so that I shall let it remain *in situ* until I am ready to remove it.

OPERATION

[Vertical incision made over inner half of anterior surface of joint: skin-edges and superficial fascia retracted.] . . . There is the strong fibrous capsule of the joint—the portion corresponding to the aponeurosis of the vastus internus: here is the patella. [Incises and retracts vastus internus aponeurosis.] There is the synovial membrane. [Incises synovial membrane, exposing foreign body.] There is the foreign body: it is free in the joint, instead of being attached by a pedicle. [Extracts foreign body and closes incision in synovial membrane.] I am making an ectropion of the cut edges of the synovial membrane, so as not to leave a raw surface within the joint-cavity.

Let the record show that we succeeded in extracting the foreign body without contacting any instrument with the synovial lining of the joint—not even the one which grasped the body.

The next step is that of performing the imbrication operation. I overlap the aponeurosis of the vastus internus with the fibrous capsule by inserting interrupted mattress sutures so as to draw the inner cut portion of the vastus internus aponeurosis down beneath (behind) the outer cut portion (technic illustrated in vol. iii, August, 1914, pp. 847–850). . . . Now we are including in the bite of the needle more of the capsular tissue than before, thereby effecting a greater degree of shortening of the vastus internus aponeurosis. [Tacks edge of outer cut portion of vastus internus aponeurosis down upon inner surface of inner cut portion, thereby completing the imbrication.] You can now see that the patella is no longer able to mount up on the outer ridge of the patellar fossa. [The limb was dressed in a straight splint and Buck's extension-apparatus was applied and left on for three weeks.]

RECAPITULATION

Let the record show that after removing the foreign body we imbricated the aponeurosis of the vastus internus with the fibrous capsule.

POSTOPERATIVE COMMENT

In this work you rarely have to use a ligature, thereby materially lessening interference with the process of repair.

Postscript.—There was complete primary union. No limitation of motion followed the operation.

[Cases of luxation of the patella have been previously reported as follows: "Luxation of patella and fracture of internal semilunar cartilage," vol. iii, February, 1914, 151–160; "Congenital luxation of both patellæ," vol. iii, August, 1914, 817–838 —illustrations of operative steps; "Recurrent luxation of left patella," *ibid.*, 839–859—illustrations of operative steps.]

BONY ANKYLOSIS OF KNEE-JOINT—THREE-STAGE OPERATION OF ARTHROPLASTY—TALK ON ARTHROPLASTY OF KNEE-JOINT

Summary: Clinical history of patient; comments—discussion and analysis of history; first operation—excision of periarticular scar-tissue interfering with arthroplasty flaps; talk on Dr. Murphy's method of treating early acute bacterial synovitis by formalin-glycerin injections and Buck's extension; planning of arthroplasty operation; second operation (two months later)—preparation of substitute for missing patella; importance of developing atrophied musculature previous to mobilizing a joint; recapitulation; third operation—arthroplasty; preparation of interposing flap; question of disposal of ligaments; question of amount of bone to be removed to permit interposition of flap; removal of loose bone-fragments necessary to prevent their acting as separate foci of osteogenesis; subpatellar and interfemorotibial fascia-fat flaps prepared and interposed; recapitulation; postoperative comments—character of dressing and of postoperative position of limb; talk on Dr. Murphy's technic for arthroplasty of knee-joint.

CLINICAL HISTORY OF PATIENT

The patient, a female twenty-nine years of age, was admitted to hospital September 10, 1914. The family history reveals the occurrence of both tuberculosis and carcinoma. The previous history is negative.

Twenty-five years previously, in 1889, when four years of age, the patient fell and cut herself upon the inner side of the knee. She recalls that the cut was a long time in healing, and that she was taken to a hospital where the knee and the leg in its lower third were lanced. When she left hospital, she wore an ambulatory brace on the limb and walked without the aid of crutches. Eventually the leg became flexed to a right angle upon the thigh, and could not be straightened.

Ten years ago, on April 12, 1904, the ankylosed knee-joint was resected, and the leg was dressed in a gypsum case. The patient remained in bed two months, until June 12th, and then got up and about with the case still on. Three months after operation, on July 15, 1904, the plaster case was removed, and on August 20, 1904, she began to walk without crutches. The knee is now ankylosed, and the limb is about four inches shorter than its fellow of the opposite side. There are scars from healed sinuses left remaining over the upper end of the tibia.

COMMENTS

DR. MURPHY (September 14, 1914): I shall not perform arthroplasty at the present time, as there is too much scar-tissue around the joint, and not enough normal tissue from which to obtain an interposing flap. I must, therefore, first endeavor to bring the periarticular tissues into a condition suitable for performing a subsequent arthroplasty. The first step is to excise the cicatricial tissue and insert a modified Wolff skin-graft in its place. It is from the fat of this graft, together with the underlying deep fascia, that I shall obtain the interposing flap when the time comes to perform arthroplasty. I request that the intern read the history, and at its conclusion I shall take up in detail the pathologic condition as it developed originally. [History read by intern.]

DR. MURPHY (to patient's physician): What can you add to the early history, Doctor?

PATIENT'S PHYSICIAN: The early history was very indefinite. The lesion was supposed to have been tuberculous.

DR. MURPHY: That question of tuberculosis is just what I want to bring out. What about her family history?

PATIENT'S PHYSICIAN: There is a history of tuberculosis on her mother's side.

DR. MURPHY: When did you first see the patient?

PATIENT'S PHYSICIAN: I saw her first eleven or twelve years ago. She does not remember having had an injury or an infection, such as "rheumatism," prior to the onset of this trouble.

DR. MURPHY: At present the clinical history of the patient offers us the only means of making a differential diagnosis at this late date as to whether the original infection involved the bone, producing osteomyelitis, or the knee-joint, producing osteoarthritis, and whether it was tuberculous in nature.

Patient's Physician: At the time Dr. Senn operated upon the limb he diagnosed the lesion osteomyelitis.

Dr. Murphy: Dr. Senn was a diagnostician of great ability, particularly in bone-lesions. Now then, Dr. Senn thought the lesion was osteomyelitis; the physician who has had recent charge of her thinks that the original infection was tuberculosis, while the intern believes it was osteomyelitis.

Now let us take the facts as they have been presented to us. In the first instance, there was an injury to the knee-joint; secondly, the patient was in hospital shortly after the injury. Following that injury, reading the story as written by the scars about the knee-joint, it looks to me as though this patient had had an acute infection, with the formation of sinuses. She remained in hospital one year, and the drainage-tubes were kept in all that time: such would not be the case if she had had pure, unmixed tuberculosis. Unless it had been a *mixed* infection, she would not have so many scars left remaining from the long-continued drainage.

I think that, from the history of this case, one is justified in concluding that it was an acute infection, and, from the clinical course, an infection *not* involving the knee-joint, but involving the bone above and below. My interpretation of it, however, is that it was not osteomyelitis, but acute infective synovitis, because it came on suddenly with swelling of the knee and the patient was apparently incapacitated at once. Following the infection, multiple abscesses formed at the portal of entry of the bacteria. There is no evidence here in front that fragments of bone were removed, such as might have been removed as the sequence of secondary osteomyelitis following the synovitis.

In brief, there is the history of injury, of immediate incapacity, of prolonged suppuration; there are evidences of many drains; and, after ten years, healing occurred with bony ankylosis of the joint with the leg at a right angle (Fig. 31, *6*, p. 176), for which resection with complete division of the quadriceps tendon was performed. There is the scar from the old incision into the quadriceps.

FIRST OPERATION: EXCISION OF PERIARTICULAR SCAR-TISSUE

The scar-tissue was entirely freed from the bone, to which the skin was adherent, and excised. The subcutaneous fat and fascia were united by two rows of catgut sutures, while the skin was united by a continuous silkworm-gut suture, so as to produce ectropion of the divided skin-edges.

POSTOPERATIVE COMMENTS

When this operative incision is completely healed and enough periarticular soft tissue has developed to afford an interposing flap, we shall perform a typical arthroplasty. If the patella is intact, so much the better. If it is not intact, we shall fashion a new patella from the convex lower surface of the femur, or else reflect downward a flap from the quadriceps tendon and suture it to the ligamentum patellæ. So reflected, if properly dealt with, the quadriceps tendon takes the place of a patella.

TALK ON DR. MURPHY'S FORMALIN TREATMENT FOR ACUTE BACTERIAL SYNOVITIS

How should we handle a similar case today? How are all such like cases handled today? If there had been a penetrating wound of the knee-joint from a knife, a piece of glass, or a splinter, we would remove the foreign body immediately and paint the operative tract with tincture of iodin, close the operative wound in the knee-joint, and inject the joint with 2 per cent. formalin in glycerin for the purpose of coffer-damming the lymph-spaces in the joint and producing an intense chemical reaction in response to the infection in the knee. The next day we would repeat the aspiration and again probably the second day, reinjecting on the second day if there were much fever. In the absence of fever, we would not reinject, but would aspirate to diminish the tension of the products of infection in the knee-joint, on the same principle that you diminish the tension of a phlegmon in the thigh.

What have I failed to mention that is of such vital importance in obtaining a good result? It is Buck's extension, which must be applied on the very first day that you receive the case. While you may not be responsible for the development of ankylosis following joint infections, you are absolutely responsible for letting the knee become flexed to a right angle (Fig. 31, *6*, p. 176), and this flexion-contracture may be prevented by applying the extension the very first day. Had this patient had Buck's extension applied the first day of the infection, that resection operation, which has interfered so much with the operation which we would like to perform now, namely, arthroplasty, would have been prevented.

Remember, no matter what the source of the infection of the synovia,—whether the tonsils, the teeth, an abscess, or a septic splinter,—the first time you see the patient you must relieve the intra-articular pressure from the tension of the exudate by aspiration and from the tension of muscular contraction by applying Buck's extension. We are going to be as slow in learning to apply extension early as we are in learning most things, but the time is approaching when we shall be held legally responsible for the deformities following arthritides as we are now held responsible for deformities following fracture, and held even more responsible, because a fracture cannot always be controlled, but an arthritis-deformity can always be controlled if seen early. Should you withhold the extension until the sixth, eighth, tenth, or twelfth day after the onset of the synovitis, the muscular contractions will have become so great that the pain due to the increased amount of force now required to straighten the limb will be practically intolerable to the patient; while if you apply the extension on the first day, you may leave the hypodermic syringe and opium at home,—where it always should be left if these cases are handled properly,—and merely by separating the inflamed surfaces of the joint, the patient will pass through the attack without having pain severe enough to require hypodermic relief.

So, too, after the formalin-injection, do not let the patient get up and about, as so many physicians let them do, and then say that you have followed our plan of treatment. In accordance with our plan, you must put the patient to bed and apply extension after injecting. We have patient after patient come in saying that he has had the "Murphy" treatment for an inflammation in the joint. "I went to my physician's office, and he injected the joint, gave me a hypodermic injection, and then sent me home." No, that is not our plan of treatment; this is not an office proposition, for following the injection the patient should be put to bed with an extension apparatus applied to the limb.

SECOND OPERATION: PREPARATION OF SUBSTITUTE FOR MISSING PATELLA

Dr. Murphy (November 11, 1914): Many years ago this girl had an infection—probably tuberculous—of the knee-joint. At that time the joint was excised, the patella removed, and the bone-ends wired. At the present time the joint is ankylosed, and we must make a substitute for the missing patella before we can perform arthroplasty. If we should make the patellar substitute at the time of performing the arthroplasty instead of before, on starting passive motion we would tear the substitute that we made for the patella. Consequently, we shall perform arthroplasty later, as the third and final stage of our plan to secure a movable joint, which the patient is so anxious to have.

The skiagram shows an exostosis in the quadriceps tendon which we may be able to make use of as a substitute for the missing patella. If this exostosis is not available for such a purpose, we shall fashion a flap from the quadriceps tendon above and reflect it downward, as we devised years ago for cases after removing the patella when involved by tuberculosis. If that [demonstrating] represents the quadriceps tendon, we make a transverse cut about three-fourths of an inch in width to the middle of the tendon and about five inches above its insertion, then cut vertically through it to within one-half inch of its insertion, dissect free, reflect downward, and attach this lengthening segment to the tubercle of the tibia or to the stump of the ligamentum patellæ that remains. By this method you get just as good union as though you had divided the normal patella and sutured it together again, and after a year the patient cannot tell, so far as the function of the joint is concerned, that the patella had ever been removed.

At the first operation in this case, two months ago, we released the old scars from their adherence to the bone, and apposed the edges of the fat and fascia, in an attempt to develop some movable tissue for use as an interposing flap when the time came to perform arthroplasty.

Note the degree of muscular atrophy that has taken place about the knee. It looks as though the quadriceps muscle had, by its division and subsequent retraction, entirely receded from its position. If so, there is no use of preparing for the final operation of arthroplasty, because it could never be accomplished in the face of retraction of the quadriceps muscle.

SECOND OPERATION

[Incision and development of operative field.] There is the subquadriceps synovial bursa: it communicates with the knee-joint in four out of five cases. . . . Here is the exostosis, from which I shall fashion an artificial patella. There is the wire, which you saw in the skiagram, and which was used in the original operation to approximate the bone-ends after excision. [Removes wire.] We have to excise all that fibrosed synovial tissue: we shall not loosen it up now, unless it pushes forward and obscures the operative field, but it must be excised at the time of the final operation of arthroplasty. . . . Here is the ligamentum patellæ: I am freeing it from the scar-tissue and retracting it. . . . Now we are turning the "wooly" side of the ligamentum patellæ inward and uniting it with the patellar tendon: there is no trouble in bringing these two structures into apposition after interposing the exostosis between them. On each side you see the divided edges of the aponeurosis of the quadriceps muscle: we now suture them together. Finally we unite the edges of the superficial fascia, so as to prevent the skin-edges from turning in. [Sutures skin-edges.]

RECAPITULATION

Let the record show that the patella was absent; that the tendon of the patella had been divided in the original operation and was still separated; that, after detaching an exostosis from the anterior surface of the femur to serve as an artificial patella, we interposed it between the patellar tendon and the ligamentum patellæ, stitching these structures to each other with chromicized gut, and then united the adjacent quadriceps aponeurosis; that we believe there will be sufficient interposing tissue available on the outer side of the knee for the subsequent performance of arthroplasty; and that we shall encourage the use of the quadriceps muscle in anticipation of the mobilization of the joint.

POSTOPERATIVE COMMENTS

The periarticular tissues are now in proper shape for subsequent arthroplasty, but the atrophied muscles—especially the quadriceps muscle—must, by massage and graded gymnastics, be developed so that the patient will have proper motor control over the joint, after we have mobilized it for her. It will take about six months to develop these muscles properly.

We believe in the reliability of a pedicled flap of fascia and fat for all arthroplasty work. We had some cases years ago in which we used a detached or free flap of deep fascia in the knee. This procedure we have abandoned in weight-bearing joints, as the results were unfavorable, but have continued its use in non-articular cases. Such a case—operated upon recently—was one of Volkmann's ischemic contracture, so severe that all the soft parts had become adherent to the radius and ulna. We dissevered the adhesions and prevented their recurrence by interposing a free flap of fascia lata between the flexor muscles and tendons and the bones of the forearm.

THIRD OPERATION: ARTHROPLASTY OF KNEE-JOINT

Dr. Murphy (May 17, 1915): Practically considered, owing to the state of ankylosis, this limb forms one continuous straight bony column from hip to ankle, and our problem today is to produce a pseudarthrosis, or nearthrosis, at the knee by performing arthroplasty. At the second operation, six months ago, I made a note to the effect that I would be able to obtain a sufficiently large interposing flap from the outer side, and I shall now loosen that flap.

[Makes incision and outlines interposing flap.] While working here on the outer side, I am bearing in mind the fact that this woman has an external popliteal nerve, and I am getting dangerously near it. . . . There is the interposing flap released from the outer side. When operating upon these cases, you must avoid hand-contacting of the tissues, and contacting with them any part of an instrument that has touched the gloved hand. Failure to observe this no-hand-contacting technic increases the chances of infection of the operative field.

Now I am detaching both lateral ligaments and throwing them out of the field. In the early days of our arthroplasty work we felt that something serious would happen if we totally removed the articular ligaments. As time went on, however, I learned that large ligaments develop about the site of a pseudarthrosis. For example, recall the case of pseudarthrosis we operated upon the other day: so dense were the ligaments which had developed that it took me an entire half-hour to remove them, thereby showing that, under favorable conditions, nature develops a ligamentous capsule when necessary in order to give support. In addition to affording a wider range of motion in the new joint, removal of the ligaments together with the capsule also obviates one of the causes of postoperative pain following arthroplasty.

The quantity of bone that has to be removed in order to permit of the insertion of the interposing flap varies materially in different cases, depending upon the degree of flexion that is present.

With a fine chisel I am rounding off the bone-ends, so as to maintain as nearly as possible the normal conformation of the end of the femur and the normal conformation of the end of the tibia, while not forgetting to reproduce the intercondyloid notch. . . . There are just a few little fragments of bone attached here to the posterior capsule, and they must be removed, because if allowed to remain, by acting as separate foci of osteogenesis, they will produce new bone and interfere with the mobility of the nearthrosis. . . . The posterior portion of the capsule is now accurately exposed: to obtain the best results, it must be removed, and in removing it I am careful to avoid injuring the popliteal vessels behind it.

Now the entire interarticular space is clear, and we are ready to interpose the flap. [Outlines, loosens, and elevates fascia-fat flap, base below, from outer side of joint, and passes it across between reshaped ends of bones.] I am covering the ends of the bones with this flap of fascia and fat and tacking it to the periosteum and other available soft tissue left remaining around the margin of the head of the tibia with sutures of catgut. I am also making an additional interposing flap of fascia and fat to go over the reshaped patellar fossa of the femur and beneath the artificial osseotendinous patella. I fear lest the cicatricial tissue should interfere with the motion of the patella, which is already involved by the fact that it is only an artificial, and not a normal, patella. Now the subpatellar flap is interposed, and all the interposing flaps are anchored. We shall remove the constrictor, and it remains merely to appose the soft parts with horsehair sutures.

RECAPITULATION

Let the record show that we had an ample interposing flap which consisted chiefly of fat, the fascia having been practically absorbed; that but one blood-vessel ligature was necessary; that there was not much blood lost; that the bone at the upper end of the tibia was not only cancellated, but was the seat of bone-absorption, appearing as though a medullary cavity were going to form across the synostosis of the femur with the tibia; that after the bone-ends were removed, we cleared the posterior recess of the joint-space thoroughly, so as to admit of an exposure of the posterior portion of the capsule; that we removed the posterior capsule together with some bone-fragments; that finally a flap of fascia and fat was freed and placed under the artificial patella and under the quadriceps tendon, so as to prevent their postoperative adherence to the femur.

POSTOPERATIVE COMMENTS

The wound will be dressed with the old-fashioned 5 per cent. phenol moist gauze, so that if there should be any postoperative oozing of blood, we hope the phenol will prevent the decomposition of the effused blood by bacteria from without. The limb will be dressed in a narrow travois splint, so as to afford a mild degree of abduction. In addition to the splint, a 15-pound weight for extension will be applied to antagonize muscular contractions which, if allowed free play, would necrotize the interposed flap by forcing the bone-ends together. Remember, the patella that is here is a newly made artificial patella, fashioned at the second operation from an exostosis which was conveniently present on the anterior surface of the femur, and which was included in the union between the quadriceps tendon and the ligamentum patellæ.

Postscript.—Primary union resulted and the case progressed without complications.

TALK BY DR. MURPHY ON ARTHROPLASTY OF KNEE-JOINT

The knee is the most difficult joint in which to secure perfect restoration of function and restoration of nearly normal joint anatomy. The ankylosis must be relieved, but the joint must be usable as well as movable; in other words, it is not sufficient to have the patient make extension and flexion of the leg while seated or standing; he must be able to bear weight on the leg and to use it in locomotion without the assistance of cane or crutches. There must be no tendency to luxation in any direction and there must be sufficient firmness in the joint to permit of its free use. That means that the normal anatomic conformation of the joint must be restored as nearly as possible.

Two parallel vertical incisions are made, one on either side of the patella. The external incision is made first, and extends four inches above the joint and three inches below it. The wound-margins are well retracted, so as to expose the field of operation. The patella is then freed from the femur with scalpel and chisel. Then the internal incision is made, only four inches long, however. Through this incision the freeing of the patella is completed from the inner side, and the line of ankylosis is separated. The ligamentum patellæ is not divided: it is merely elevated and retracted to one side. The curved chisel is then used to separate the femur from the tibia on each side, and every effort is made to restore the normal anatomic curved conformation of the joint-surfaces. The curve of the chisel corresponds to the normal convexity of the condyles of the femur. If the ankylosis is bony and involves a considerable portion of the articular surface of the inner or outer condyle or both, the normal curvature of the condyles is reproduced. With a smaller curved chisel the corresponding tuberosity (or both tuberosities) is restored by excavation, making the cavity deep enough to permit the extended leg to assume a straight position without putting tension on the popliteal structures or compressing the interposed flap, and to restore the normal relationship of the femur and tibia as nearly as possible. Every effort is made to secure this end. The intercondyloid fossa and the intercondyloid ridge are reproduced, but in a slightly exaggerated degree, so as to insure stability of the new joint.

The normal conformation of the anterior surface of the femur must be preserved, in order that the patella may subsequently find its natural resting-place. Therefore, in executing the chiseling, the instrument should be directed upward and inward toward the median line from both sides. The same chisels are used in this operation as in the hip-arthroplasty, suiting the size and shape of the chisel to the work to be done.

Two lateral rectangular flaps, measuring 2¼ inches in length and breadth, are fashioned from the inner and the outer side of the joint—each flap including capsule, ligament and subcutaneous fat. The base of each flap is directed downward, and is left attached to the base of the tuberosity, just below the line of bone-division to be made later. This flap must include all the lateral capsule, fascia and fat, which together will serve as the interposing membrane to be placed between the freshened bony surfaces of the tibia and femur and prevent the recurrence of ankylosis.

There are four methods of dealing with the patella, of which the simplest one—and the one which after operation gives additional leverage to the quadriceps tendon—is that of rotation of the patella, or "turning the patella turtle." This rotation is carried out by freeing the vastus externus and internus attachments to the quadriceps tendon for a distance of two inches above the patella; next, displacing the patella from side to side during the operation. When the limb is straightened out and the interposing flap is in position, the patella is separated from the overlying skin and fat by blunt scissors-spreading dissection extending upward over the quadriceps and downward over the ligamentum patellæ to its attachment, a 180-degree rotation of the patella is made, so that the upper surface, or bursal side of the patella, now becomes its articular surface, and the prepatellar bursa aids in making a lining for the new joint. The upper surface of the patella is now trimmed down with bone-cutting forceps until it is smooth and level. The vastus externus and internus are now sutured to the opposite sides of the quadriceps tendon from which they were freed, to prevent luxation of the patella and a return to its former position.

I have encountered cases in which so many operations had been performed about the knee-joint that even the capsular flap could not be secured in the adjoining tissues. Then I resorted to the final or third means for securing the interposing flap. After denuding the bone and freshening its surfaces, molding them, removing as much bone from the upper end of the tibia or lower end of the femur as was necessary completely to extend the limb, I took a portion of fascia lata and trochanteric bursa with the overlying flap of fat, measuring 3½ by 5 inches, from the patient's hip and interposed it *en masse*, in the knee-joint, sutured it first to the posterior condyloid portion of the capsule; secondly, brought it clear over the anterior surface of the femur and lower surface of the patella; thirdly, accurately sutured it on both sides and at both ends, so that it covered all the lower end of the femur and prevented bony contact of either the patella or tibia with the femur. The flap healed *per primam*. The immediate result was perfect: there developed not a "sliding pseudarthrosis," but a fibrous fixation with practical immobilization fourteen months after the operation.

Having made the skin-incision as described, exposed the joint, made the flaps, and separated the patella from its attachment to the femur, we are now ready to sever whatever ankylosis may exist between the femur and the tibia. This is also performed by means of a carpenter's or cabinetmaker's chisel, using both grooved and straight, as may be necessary.

The points to be observed at this stage of the operation are: (1) The normal conformation of the articular surface of both the tibia and the femur must be reproduced as nearly as is possible, so that luxation of the joint will be prevented. (2) These surfaces must be so fashioned that the leg is strictly plumb. (3) Sufficient bony tissue must be removed so that the pressure brought to bear on the interposing tissue flap when the limb is straight will not be great enough to cause pressure-necrosis.

It is not always necessary to change the conformation of the articular surface of these bones, because the ankylosis in the case may have been limited to bony union between femur and patella. As a rule, however, most of these cases are of long standing, and there is always some bony union between all the bones of the joint. A good fit should be secured between the intercondyloid notch of the femur and the intercondyloid ridge of the tibia, because it is by the accomplishment of this alone that the femur can be steadied and luxation of the tibia prevented.

It is at this stage of the operation that the interposing flaps are placed in position. These flaps are drawn inward, one from either side of the joint, over the head of the tibia, and are accurately sutured to each other over the intercondyloid ridge, a few stitches on the anterior edge securing the flaps to the base of the ligamentum patellæ. The posterior margin of each flap is sutured to the posterior wall of the capsule—which, it will be remembered, has not been disturbed at any stage of the operation. The object in view is to fix these flaps permanently on the articular surface of the tibia, so that every part of the freshened bony surface is covered by this tissue. The suture material used is phosphor-bronze wire for the deeper sutures and chromicized catgut for the periarticular sutures.

It is now that the work on the patella is performed as described above. If the knee has been flexed to a considerable degree for a long period of time, it may be necessary to shorten the quadriceps tendon. This tendon is vital to the motion of the joint. The patella, on the other hand, is of less importance—in fact, I have been able to demonstrate time and time again that it may be removed entirely, and yet a splendid result may be obtained.

It is not always necessary to rotate the patella, except when ankylosis is liable to recur. As a rule, however, I rotate the patella as described above, suture the vastus muscles in place, remove the constrictor, and close the wound. This closure is the same as that described in the operation on the hip.

As stated, the results in the knee are more difficult to secure than in any other joint. This is so because the knee-joint must be mechanically perfect and plumb, so that it may be freely movable, without causing any pain or discomfort.

The wound is closed without drainage. The skin is freely powdered with bismuth subiodid, a collodion dressing is applied, with a 5 per cent. moist phenol gauze over this, and then the usual dry dressing. Buck's extension-apparatus with a 12-pound weight is attached to the leg and worn continuously to reduce the interarticular pressure, thus preventing necrosis of the flaps, and to maintain the limb in a straight position. The limb is placed in a wire-cage trough splint. Passive and active motion are begun, as after the hip-operation. When these patients become ambulant, we apply a laced leather splint, or legging, reaching from groin to ankle. This splint is patterned after the plaster mold of the leg, so as to secure an accurate fit and give the needed support to the knee. To favor increased flexion of the limb, the patient bends the knee passively and uses a machine to force flexion and extension, made by Knoke and Dressler, of Dresden, Germany.

HYPERTROPHIC VILLOUS SYNOVITIS OF KNEE-JOINT—SYNOVIAL CAPSULECTOMY

Summary: Clinical history of patient; examination; comments—analysis of history; comparison with similar cases; preliminary measures in preparation for operation; the exploratory incision; hydrops of knee-joint most commonly tuberculous; site of lodgment of B. tuberculosis in relation with joint; first operation—exploratory exposure of joint; subsynovial layer thickened and synovial membrane itself fungoid; closure of wound; recapitulation; post-operative comments—synovial capsulectomy indicated for greatly thickened synovial membrane; arthroplasty must not be performed in presence of existing infection. Second admission: Comments—recurrent hydrops a sign, not a pathologic entity; the diagnostic wheel; discussion of previous operation; third, operation—thickened synovial layer of capsule excised; cartilage covering femur found eroded; control hemorrhage by crushing, in preference to ligating; closure of wound. Subsequent note.

CLINICAL HISTORY OF PATIENT

The patient, a male thirty-six years of age, was admitted to Mercy Hospital April 20, 1915. The family and past histories are negative.

Over four years ago, in February, 1911, the patient noticed a swelling the size of an olive in the right popliteal space. Six months later it had reached the size of an egg, and began to interfere with flexion and extension of the leg. The swelling was circumscribed and fluctuated, but caused no pain.

Nine months later, in November, 1911, the tumor was removed through the popliteal space at his home town. (We do not know that a microscopic examination was made.) The patient was informed that the swelling was due to a bursal cyst, which was not connected with the synovial lining of the knee-joint. On the second day after operation pus began to be discharged from the wound and continued being discharged for two weeks. For four days the patient was feverish (temperature, 103° F.), but there were no chills. At the expiration of three weeks the wound healed, and there has been no discharge from it since; the patient walked without difficulty, and felt quite well.

Ten weeks after the operation, in January, 1912, a little dull ache appeared in the right knee and was followed by swelling, which increased markedly. The pain lasted four weeks. Chills and fever were absent. The patient walked on the limb with the aid of a cane, and continued his professional activities.

Since January, 1912, the swelling and dull ache have been subsiding and recurring every month or two, after periods of hard work. At each acute exacerbation the knee swelled and remained painful for three days, and the patient took to bed and remained there until the pain subsided.

The patient has not been subject to sore throat, nor has there been any sinus-trouble. Seventeen years ago there was an infection in the upper incisor tooth, and the tooth was drawn. Seven years ago the patient noticed on awakening in the morning that his fingers were occasionally stiff, and sometimes his neck was stiff. This early morning stiffness continued four years. Ten weeks after the operation upon the knee his teeth were examined, and an ancient abscess was found and treated until it eventually healed. For three months the patient took autogenous vaccines, prepared from the alveolar abscess. His general health is good.

Examination by Dr. Murphy (*June 1, 1915*).—In the anteroposterior view the skiagram indicates that the semilunar cartilage is very much thinned by disease, but the lateral view shows no change in the bony conformation of the joint. The area of greatest sensitiveness is just above the external tuberosity of the tibia. Tuberculin, Wassermann, and luetin tests were negative. The patient's fingers are clubbed.

COMMENTS

DR. MURPHY (June 2, 1915): There is no evidence that the patient had ever suffered an injury to the internal semilunar cartilage. Over four years ago a bursal cyst first made its appearance in the popliteal space: whether that cyst was an enlarged bursa not communicating with the joint-cavity, or a displaced portion or diverticulum of the synovial layer of the capsule with a normal lining, I do not know. After the operation infection of the wound ensued, which, however, lasted for a few days only, and then subsided entirely. There is no history showing that there was an infection of the interior of the knee-joint following operation. Since that time the patient has had a classic recurrent hydrops of the knee, in all probability associated with a foreign body or a movable semilunar cartilage.

The patient whom we operated upon Saturday for recurrent external luxation of the patella (*vide supra,* p. 135) gave a history of trauma followed by recurrent attacks of synovitis with effusion, the underlying cause of which was a loose cartilage in the joint. This patient, however, did not give any history of trauma.

Recall the patient whom we operated upon about three weeks ago—also a physician: the only injury he had received was while jumping *up onto* a fence. At first there was pain in the knee, which disturbed him slightly for the next few days. There were also recurrent disturbances, but never was there typical locking of the joint. We found the internal semilunar cartilage split circumferentially from the midpoint behind clear around to the midpoint before, so that one-half of the cartilage rested across the joint the whole time, incapacitating him (vol. iv, August, 1915, p. 779).

While this patient does not give such a history, still our interpretation is that the joint-capsule is thickened, and that possibly, as a result of this thickening, it extends into the joint and becomes pinched; or that a cartilage, loosened from its moorings from the enormous hydrops, suddenly becomes pinched. It is more likely a hyperplasia of the synovial membrane which forced the latter in between the articular surfaces when the knee was in action.

In preparing this patient for operation, first we removed his tonsils, which were the source of the recurrent infections; secondly, we injected the joint with 2 per cent. formalin in glycerin, so as to coffer-dam it prophylactically against infection by the provocative polymorph-leukocytosis. (For method and rationale, see vol. iv, December, 1915, p. 1224.) With the joint thus injected, after removal of the cartilage the rule is that there is no postoperative effusion at all. The absence of effusion always means less risk of infection, and the presence of effusion means more risk.

At the 1914 meeting of the American Medical Association, Corner, of England, suggested a method for exploration of the knee-joint, in which first the quadriceps tendon, then the patella, and finally the ligamentum patellæ are split in the midline and retracted to each side. Such an extensive exposure gives one a good opportunity to examine the joint: laterally placed incisions answer the purpose just as effectually, and through them you can inspect both sides of the joint with equal facility, as in the patient whom we operated upon Saturday, whose entire knee-joint we inspected by merely lifting up the patella.

No-hand contacting technic is essential in the operative manipulations in these joint-cases: every time you touch the synovial membrane you increase the danger of infection.

The most common cause of hydrops of the knee-joint is tuberculosis. Except in very young children, primary synovial tuberculosis rarely attacks the knee-joint. Tuberculosis begins in the adjacent epiphysis of the femur, or of the tibia, and often is confined to the epiphysis for many years before working its way through the latter into the joint, while during this entire "incubation" period effusion floods the joint after exercise or trauma, but particularly after exercise. Often there is a chronic effusion in the joint, indicating that the infection is very close to it. Such an effusion is identical with the effusion in the tunica vaginalis, which is provoked by tuberculosis of the epididymis; and it is also identical with the pleural effusion accompanying pulmonary tuberculosis. It is symptomatic and defensive, rather than offensive. [For a talk on the pathology of metastatic arthritis see vol. iv, December, 1915, 1221.]

OPERATION

[Horseshoe incision, base above, made around patella: flap elevated (Fig. 22).] . . . There is the fibrous capsule: I am picking it up and dissecting it free from the loose, vascular subsynovial layer just beneath, which looks inflamed and thickened, and I am going to excise a piece of it for examination. . . . As I incise this subsynovial layer, I expose the inflamed synovial membrane itself; and as I incise it, in turn, you see synovial fluid welling forth in large quantities. I wish you to see that fungoid growth of synovial membrane (Fig. 22): it is the detachment of such hypertrophied villi that finally produces rice-bodies (vol. iv, December, 1915, 1230).

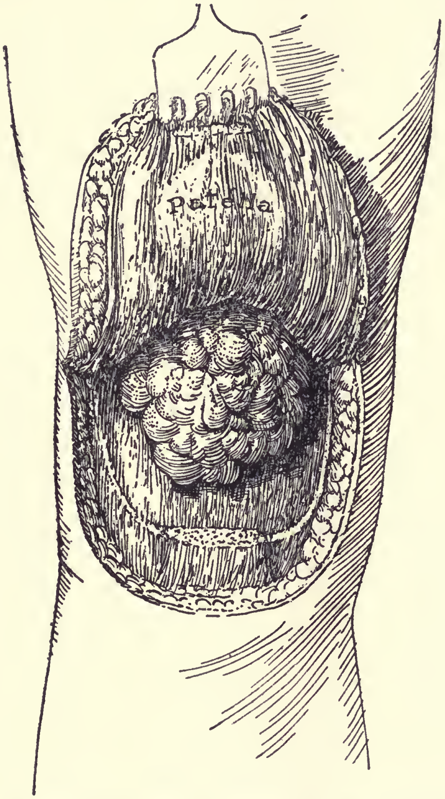

Fig. 22.—A fungoid growth of synovial membrane appears upon upward reflection of the flap.

In the presence of such an enormous thickening of the synovial membrane the only operative measure that promises permanent relief is that of synovial capsulectomy; but since we did not obtain the patient's permission for such a radical procedure, we can today do nothing more than explore the joint. [Reunites fibrous capsule with catgut and then superficial tissues with tacking sutures of silkworm-gut.]

RECAPITULATION

Let the record show that the true synovial membrane is from ½ to ¾ inch thick, and that it has a number of villi which, becoming detached, formed soft rice-bodies.

Let the record show further that, before opening the joint, the tissue beneath the fibrous capsule revealed, upon clinical examination, great edema and infiltration, indicating that this subsynovial layer was the seat of the basic infection.

POSTOPERATIVE COMMENTS

In the presence of such an hypertrophied synovial membrane, hemophilia is occasionally found to exist.

From the extent of the pathologic lesion here it is evident that no measure will effect a permanent cure short of excision of that hypertrophied synovial tissue (synovial capsulectomy) with the possible result of a stiff knee temporarily; later performing arthroplasty, if ankylosis result, to give the patient a movable knee. Arthroplasty cannot be performed at present because this pathologic type of tissue will not withstand implantation without the chances of its becoming infected. Wherever we find a focus of active disease in a joint we discontinue any attempt to perform arthroplasty. We once had two tuberculous arthritic cases and one typhoid, in which we found pus. After performing arthroplasty we succeeded in obtaining fibrous union, but not a serviceably movable joint. Now, instead of hazarding the interposing flap by performing arthroplasty in the presence of infection, we merely incise, rid the joint of pus and close up, and then wait until the joint is entirely healed before performing arthroplasty.

Whether or not the infection that produced the chronic hypertrophic synovitis is the sequence of the infection which the patient had at the time the bursa was excised, we do not know; but our interpretation of it is that it is a local infection of independent origin.

SECOND ADMISSION

DR. MURPHY (June 8, 1915): What is the matter with this patient?

INTERN: In keeping with his statement there is recurrent hydrops of the knee the result of chronic infection.

DR. MURPHY: Recurrent hydrops of the knee is merely a clinical sign—not a pathologic entity, but a sign. It is only one of the signs that this mass presented.

A diagnosis is made up of a number of symptoms and signs which are properly correlated in a definite relationship with each other. The simile which I have used in this Clinic to emphasize the difference between a set of symptoms jumbled up and a set of symptoms properly correlated is that of comparison with a wheel. You will say that a hub, spokes, a felly, and a tire make a wheel: but do they make a wheel? No: dissembled, they make a mass of junk; but when the hub, spokes, felly, and tire are assembled and built in proper relationship with each other, then you have a wheel (vol. iii, April, 1914, 195—illustration of wheel). A forcible illustration of this simile is found in the inter-relationship of the symptoms and signs in the diagnosis of acute appendicitis. Appendicitis, when acute, usually manifests itself clinically by the sequence of pain, nausea and vomiting, local tenderness, fever and leukocytosis; but fever, pain, nausea and vomiting, local tenderness, and leukocytosis do not indicate acute appendicitis, because appendicitis never begins with initial fever. See the difference? The moment you change the inter-relationship and alter the sequence of the symptoms and signs, then you have to change the diagnosis.

At the previous operation we found in this patient's knee-joint a mass of hypertrophied synovial villi, associated with hydrops, and a large number of rice-bodies. The hyperplasia resulted from irritation of the synovial membrane, causing effusion with edema and swelling of that membrane, which, by being pressed between the ends of the joint, was pinched and traumatized. The possibility of repairing this knee-joint by any other method than that of excision of the synovial layer of the capsule is out of the question. The plan of repair we intend performing here calls for synovial capsulectomy, followed by arthroplasty, if ankylosis result. The type of infection at work in this knee-joint has not been determined.

OPERATION

We are going through the incision, which we made at the time of the exploratory operation. [Divides ligamentum patellæ, exposing joint.] I wish you to see how thoroughly disorganized that joint is. That fungoid synovial mass is from the bursa beneath the patellar ligament: it is from 1/3 to 1/2 inch thick (Fig. 23). We shall excise it by making a spreading dissection between the fibrous and synovial layers, and then it will come out rapidly.

As I reach the upper part of the joint I encounter the quadriceps tendon and free it by working beneath it. . . . [Elevates patella, ligamentum patellæ, and quadriceps aponeurosis, exposing inflamed and infiltrated synovial layer of capsule.] Note how this process has burrowed away over to the side, showing how futile injections of formalin and glycerin, or of anything else in this type of lesion, would have been. . . . I have now reflected all the fibrous layer of the capsule, and there comes into view the synovial layer, which has been constantly pinched. Note these elongated villi that have been caught between the ends of the bones and traumatized continually (Fig. 23). Judging from appearances, I should say that the "bursal" tissue which was removed from behind at the first operation was identical with this tissue in front, and that it consisted of an elongation or a diverticulum of the capsule which extended posteriorly. [Excises synovial capsule.] The cartilage covering the ends of the femur shows an erosion beginning just inside the margin of the joint—evidently corresponding to the point of maximum friction during the movements of the inflamed joint. This erosion is similar to that which was described many years ago by von Recklinghausen.

With both semilunar cartilages in such good condition we shall not remove either one. The enormous cavity that extended up beneath the quadriceps muscle is due to the burrowing of a large diverticulum from the capsule. That is the thickest synovial capsule which I have ever seen: it weighs several ounces, and can be demonstrated beautifully by floating it out upon water.

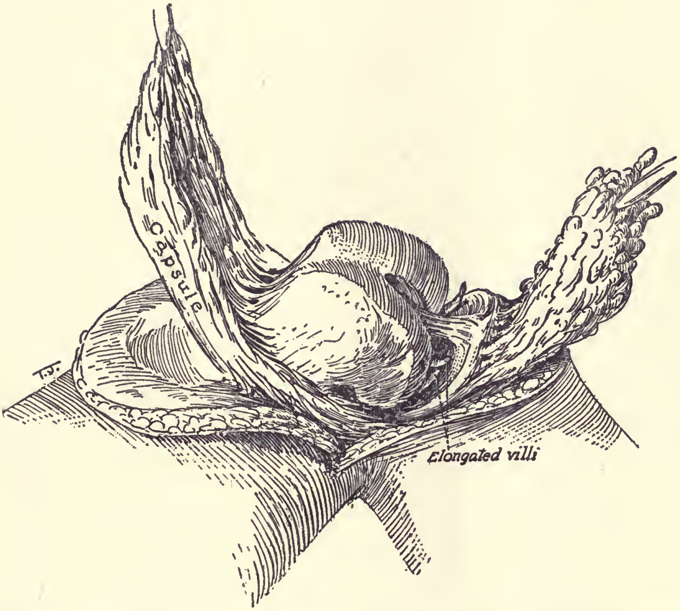

Fig. 23.—From above downward note thickened synovial capsule; elongated villi; flattened from being caught between ends of bones; hypertrophy of synovial fatty tissue of deep infrapatellar bursa, forming a fungoid mass.

In effecting hemostasis we crush the bleeding vessels with a blunt instrument, and as a rule this is all that is necessary. We prefer not to use ligatures, but do use them if we must.

Let the record show that the whole operative field was sponged over with a 5 per cent. solution of phenol, and that all the sponges used were removed from the joint before closing it.

I am now suturing the divided ligamentum patellæ and the cut edges of the aponeurosis. . . . [Closes superficial fascia and skin without employing drainage.]

In order to lessen the oozing we shall keep the foot at an elevation of from 15 to 18 inches. If a hematoma forms, it will be aspirated tomorrow, and again the next day, so that none of the blood which oozes out will enter the joint, and the joint will remain dry. By timely aspiration, one has little or no trouble from the hematoma.

Let the record show that this enormously thickened synovial capsule was enucleated by a spreading dissection, which separated the external fibrous layer of the capsule from the synovial layer, and that it was then sent to the Laboratory of Surgical Pathology for bacteriologic examination.

Postscript.—This case united *per primam.* At the end of eight weeks the patient began passive motion, and he has had no untoward symptoms.

Note from patient to Dr. Murphy (*October 16, 1915—four months after operation*): "I have been up and about for two months, having regained 30 degrees of motion in my knee-joint, and am now able to get around without crutches."

HYPERTROPHIC VILLOUS SYNOVITIS OF KNEE-JOINT—SYNOVIAL CAPSULECTOMY

Summary: Clinical history of patient; examination—at first glance knee suggests *tumor albus;* comments—the mechanics of hypertrophic villous synovitis; operation—exposure of joint by author's incision for exploration of knee; diagnosis from tuberculosis; synovial membrane excised; futility of "Murphy treatment" by formalin-glycerin in presence of such an extensive pathologic lesion; subpatellar arthroplasty; recapitulation; postoperative comments—when to institute *active* motion; dangers from forced passive motion; tendency of cases of villous synovitis to bleed.

CLINICAL HISTORY OF PATIENT

THE patient, a male forty years of age, was admitted to Mercy Hospital November 18, 1915. The family, past, and personal histories are negative.

Twenty years ago, in 1895, at the age of twenty, the patient fell while playing football and struck his left knee upon the frozen ground. While he was not totally incapacitated, his knee was very sore for four or five days thereafter. At the end of eight or ten days he noticed the knee beginning to swell, but still it did not pain very much, for he was up and about, limping only slightly. A physician applied a tight bandage to the knee, and under its influence the swelling subsided for a time, but the knee never wholly recovered itself, for after walking a long distance the swelling became worse. By resting more frequently and wearing a knee-cap the condition of the joint improved, and there followed a period of two years during which the annoyance was at the minimum.

At the end of the two-year period the patient paid no further attention to the knee, daily standing all day long in a store, and the trouble recurred worse than before. Since then the knee-joint has been aspirated repeatedly, and has been injected several times with 2 per cent. formalin in glycerin, but with little improvement.

Four years ago, in 1911, the knee was operated upon, and at the operation a fringe of synovial lining was resected. After the operation the patient was perfectly well for two years, but at the end of that time the trouble returned. At present he can flex the knee almost to a right angle, but cannot extend it fully. He walks without a very noticeable limp.

Examination by Dr. Murphy (November 18, 1915).—Pain on the inner and outer sides of the knee causes the patient to limp. The skiagram reveals exostoses on the side, signifying chronic osteoarthritis. On superficial examination the knee-joint resembles one the seat of *tumor albus*, or white swelling.

COMMENTS

Dr. Murphy (November 24, 1915): This is a case of recurrent hydrops of the knee following trauma. The previous operation, at which a small portion of the capsule was removed, involved the ablation of hypertrophied villi. After operative exposure of a knee-joint the seat of villous synovitis it is found that the ends of the hypertrophied villi, having been caught and flattened between the bone-ends during flexion and extension, have set up continual intra-articular effusion, which interferes with the movements of the joint.

About six months ago we had to deal with a knee-joint which was similarly afflicted, but which had not been previously operated upon. We performed capsulectomy. The latest reports state that the patient can flex the knee to a right angle. After having performed capsulectomy one cannot accurately prognosticate to what extent the range of motion will eventually be restored; but in any case there results a sufficient degree of flexion to give a serviceably sound knee: there is a difference between "serviceable" and *serviceably sound.*

Our patient has had this knee trouble since his student days, and the operative proposition before us is to establish a joint that will be free from pain, whether by performing resection, which results in a stiff joint, or arthroplasty, which results in a movable joint.

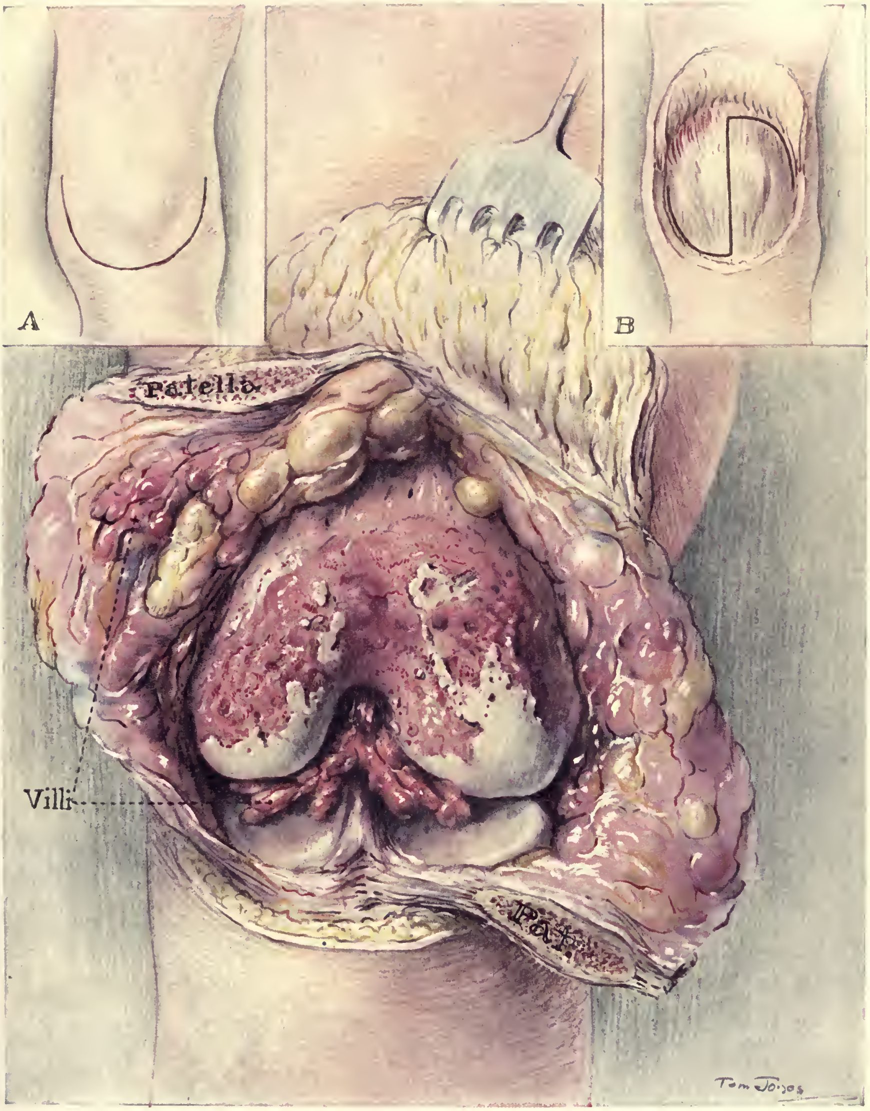

Fig. 24.—Enormous villous hypertrophy of synovial membrane; erosion of articular cartilage of femur. Weight of former when excised, ¾ of a pound. Semilunar cartilages have been removed, showing intact articular cartilage of tibia. *A* shows swollen joint and curved skin-incision; *B* shows **S**-shaped division of osseo-aponeurotic anterior wall of joint. (Sketch made at operating-table.)

OPERATION

In this case the method of exposure is a matter of much moment. How can we lay open the joint with the least damage to the patella and its associated fibrous structures? By employing the method which we originated. [Exposes joint-cavity by first reflecting horseshoe flap of skin and fat and then by a V-shaped incision of quadriceps tendon, patella, and ligamentum patellæ (Fig. 24, A, B); see also p. 184.] . . .

As we divide the synovial membrane the gelatinous hydrops-fluid escapes from the joint-cavity. . . . Here is the subquadriceps bursa. The synovial membrane is infiltrated to the depth of an inch in many places. Look at these villous masses (Fig. 24). The cartilage covering the bone-ends is eroded in places, and you can readily understand how, in the later stages of the pathology of this disease, that cartilage eventually becomes destroyed. We must excise both semilunar cartilages, because they are thickened and raised up by underlying pockets of exudate, and have undergone attrition from the movements of the joint. I wish to call your attention to the fact that the joint is more diseased above than below. There is no firm cartilage left to permit of any free motion. This disease is not tuberculosis: it is hypertrophic villous synovitis, and aside from the erosions, the bones are not intrinsically affected. [Excises hypertrophied synovial membrane.]

That joint was completely wrecked by the disease. How fruitless the "Murphy treatment" of formalin-glycerin would have been in that kind of knee! In a medicolegal case which was tried in Virginia an effort was made to place the blame for a bad result in a joint-case upon formalin-glycerin injections. After the decision had been handed down by the Supreme Court, upon being consulted in the matter, I said that the injection of the fluid did not have much to do with bringing about the bad result; and that formalin-glycerin injections must not be used with a syringe alone, but with *brains* as well: the case was in no way suitable for such injections, nor was it the type of case in which we advise this treatment.

Lest the patella should become adherent to the freshened bony surface of the femur, I am interposing a flap of fascia and fat beneath it, so that it will have a nice, soft, fatty cushion upon which to play (*vide infra*, p. 186). [Closes **S**-shaped incision with phosphor-bronze wire, as described below, p. 186.] . . . Now you see how securely we have closed the opening into the joint: the more the quadriceps contracts, the more firmly the cut-edges of the patella are drawn together (*vide infra*, p. 186). [Skin-incision closed with horsehair: limb dressed in wire-screen and Buck's extension-apparatus applied.]

RECAPITULATION

Let the record show that after reflecting a horseshoe flap of skin and fat with base above, we divided the outer half of the quadriceps tendon and then sawed through the patella in a direction which was parallel with the long axis of the leg; that we next divided the inner half of the ligamentum patellæ, leaving the outer half of the patella attached to the ligamentum patellæ below and the inner half attached to the quadriceps tendon above, so that the strength of the patellar attachments is permanently maintained, and, after the patella, split in its long axis, is united by transverse sutures, traction exerted upon it from either end cannot separate the patellar halves during the process of repair.

Let the record show further that after reflecting the osseo-aponeurotic flaps the joint-cavity was found full of gelatinous material; that the margins of the articulation showed an enormous number of cartilaginous knobs; that the synovial layer of the capsule was dissected free down to the margin of the cartilage covering the bone-ends, and was then removed; that except where eroded the articular cartilage was fairly well preserved, so that we already have within the joint a good, firm, smooth cartilaginous covering of the bone-ends; that the external semilunar cartilage was worn down to a shred at one angle and destroyed, forming a typical semilunar cartilage fibrous mass, and the internal semilunar cartilage was equally wrecked, and both cartilages were excised. At the close of the operation practically all bleeding had stopped, so that it was necessary to apply but one ligature.

POSTOPERATIVE COMMENTS

We shall not encourage motion in this joint until time has elapsed for a fairly firm union of all the soft parts and of the patella, which requires six weeks. At the end of that time we shall institute slight *active* motion, which will be slowly increased until there is attained a fairly wide range of motion. By depending upon active motion for results the tissues will not be so much destroyed as from forced passive motion. Each additional laceration of the joint-tissues means additional trauma, additional hemorrhage, additional clotting, additional fibrous tissue, and additional cicatricial tissue, so that passive motion must be administered *with cortical cells* if one would obtain the best result. You cannot tear the joint-tissues every two or three days through injudicious passive motion and expect ultimately to get a movable joint, for under such conditions the sequel will be ankylosis of the joint. Once passive motion has been begun, by gradually increasing the range of motion—though never to the degree which causes pain to arise—you can finally procure a movable joint.

The etiology in this case was recurrent trauma. The thickening of the synovial membrane was not so extensive as it is in many of the cases of loose cartilage in the joint. This synovial thickening is apt to be greater in stout women as they climb the fifties. In the rheumatoid joint conditions, also, thickening of this type occurs. The joint is now lined everywhere by the fibrous capsule. It is much more difficult to infect this joint than to infect a normal joint, because the articular and periarticular tissues are coffer-dammed by being infiltrated, and the layer where infection lodges—the subsynovial—has been removed.

Many sufferers from this type of disease exhibit a decided tendency to bleed, and profusely. My attention was first called to this liability to hemorrhage in the early eighties, when I performed a small operation upon a joint involved by hypertrophic villous synovitis. Later, in looking up the literature, I found that Volkmann, in *Deutsche Chirurgie*, referred to the frequency with which these joint-changes occur in patients with a hemorrhagic tendency.

Postscript (*January 4, 1916*).—There was complete primary union. Already there is a considerable degree of flexion. There is no pain, and the patient is able to bear the full weight upon the leg. (See also preceding case.)

ANKYLOSIS OF KNEE-JOINT FOLLOWING A FURUNCLE—ARTHROPLASTY. TALK ON THE TREATMENT OF INFECTIVE SYNOVIAL ARTHRITIS IN THE ACUTE STAGE

Summary: Clinical history of patient; comments—analysis of history; danger of "milking" a furuncle; furuncle as a primary focus for metastatic osteomyelitis and synovial arthritis; arthroplasty now an established procedure; interposing fascia-fat flap in knee-arthroplasty obtained with difficulty in young lads, but with ease in women and girls; reasons why this case is unfavorable for arthroplasty; operation—U-shaped incision; patella found adherent to external condyle, and femur to tibia; typical arthroplasty of knee-joint performed; recapitulation; postoperative comments; talk on treatment of infective synovial arthritis in acute stage.

CLINICAL HISTORY OF PATIENT

The patient, a male twenty-three years of age, was admitted to hospital April 19, 1915. The family history does not reveal tuberculosis.

The source of the present trouble was a furuncle which the patient had on the nape of his neck in November, 1913. The boil was irritated by squeezing, and in from seven to ten days after its appearance, severe pain, followed by swelling, developed over the scapular spine: this swelling was incised, and bony sequestra were removed.

In January, 1914, the left knee-joint became inflamed, and remained swollen and painful for nearly one year. During the last four or five months it has been ankylosed and therefore practically painless. The osteomyelitic process in the left scapula is now entirely healed. His general health is good.

Examination by Dr. Murphy.—The left knee-joint is ankylosed in the position of a few degrees of flexion. There is complete bony adherence of the patella to the femur, as well as of the tibia to the femur. There is but a small quantity of fat around this knee-joint, so that we shall have some difficulty in obtaining enough interposing tissue.

COMMENTS

DR. MURPHY (April 21, 1915): That history is typical and classic—classic in the clinical mistakes it revealed, as well as in its clinical course. First, the patient had the furuncle; he incised it and, not satisfied with the progress it was making, began to "milk" it. Callender was wont to say, in the early days, "Do not milk an abscess. Get the tension off and it gets well." The patient's sister then milked the furuncle and pressed the microorganisms into the blood-stream, and the next thing that occurred was pain in the neighborhood of the shoulder, which was not due to synovitis, but to osteomyelitis involving the spine of the scapula and producing subsequent necrosis with sequestrum-formation. After incision and removal of the sequestra, the osteomyelitic process healed. Evidently the shoulder-joint itself was not involved, for it is now perfectly free of disease.

The next salient point in the history is that the left knee-joint became involved by metastatic infection, and was incised in several places, and drained with rubber tubes: this was followed by subsequent ankylosis.

The osteomyelitis of the scapula was metastatic from the furuncle: we have had a number of these cases of metastases from furuncles. I recall the case of a young girl with a furuncle on her arm, which was meddled with by squeezing until, by metastasis, acute infective osteomyelitis developed in her tibia (Figs. 25, 26, 27) and produced an enormous sequestrum, and the infection invaded the knee-joint by contiguity (Fig. 28), ultimately resulting in ankylosis (Fig. 31, 6). We first performed sequestrectomy and, at a later operation, arthroplasty. Now she could walk through this arena, with the class breaking about even in guessing which knee-joint was operated upon, so perfect is the motion, as you see in the picture [indicating], and as you can see in so many of these pictures. An arthroplasty is no longer a fantastic procedure, but an accomplished surgical feat that, like other surgical achievements, yields uniformly good results under

A SERIES OF SEVEN SKETCHES SHOWING THE RAPIDLY DEVASTATING MARCH OF ACUTE PYOGENIC OSTEOMYELITIS AND THE URGENCY OF GIVING IMMEDIATE OPERATIVE VENT TO THE PUS

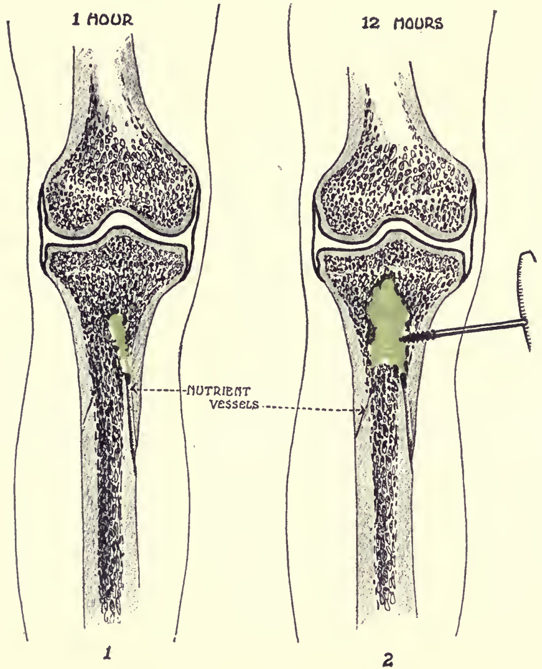

Fig. 25.—1, The metastatic infective focus in its incipiency, close to the medullary orifice of the nutrient canal; 2, the focus has spread, but is given early and timely vent by the gimlet. A chronic focus at this site, or one at the lower end of the tibia, constitutes Brodie's abscess.

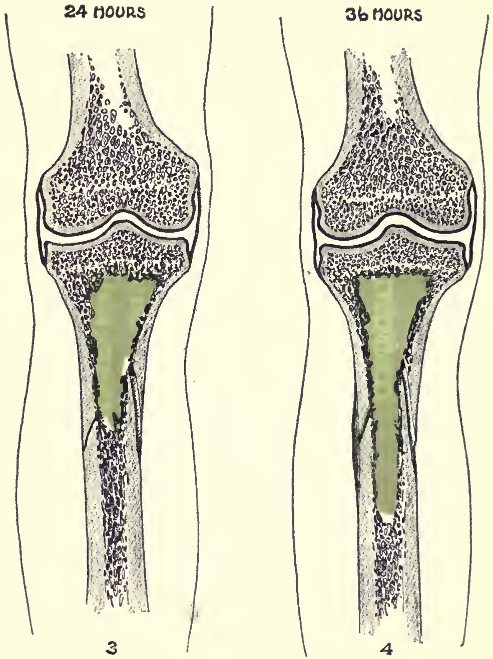

Fig. 26.—3, 4, The march of pus in the untreated case, sweeping through the medulla like wild-fire.

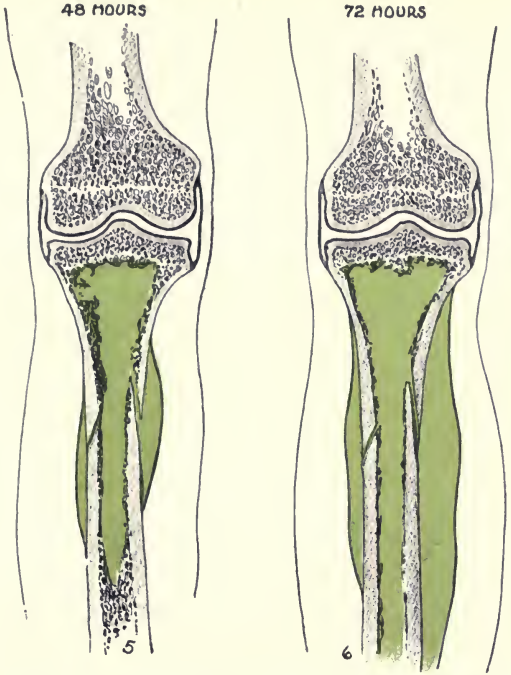

Fig. 27.—5, Escaping through the nutrient canals the pus encounters and elevates the periosteum and, still without vent, continues its march through the medullary cavity (6). Edema of soft tissues appears.

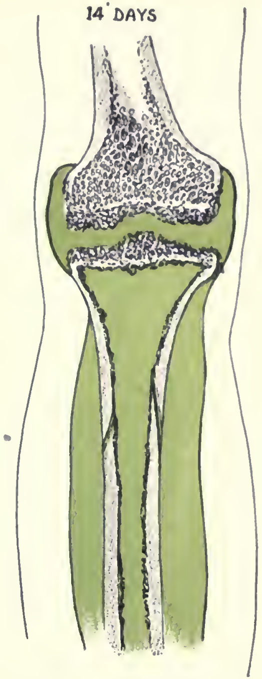

Fig. 28.—7, Extending upward beneath the periosteum, the pus circumvents the epiphyseal barrier and attacks and enters the knee-joint.

A SERIES OF SIX SKETCHES SHOWING THE COURSE OF NEGLECTED METASTATIC SYNOVITIS OF KNEE-JOINT

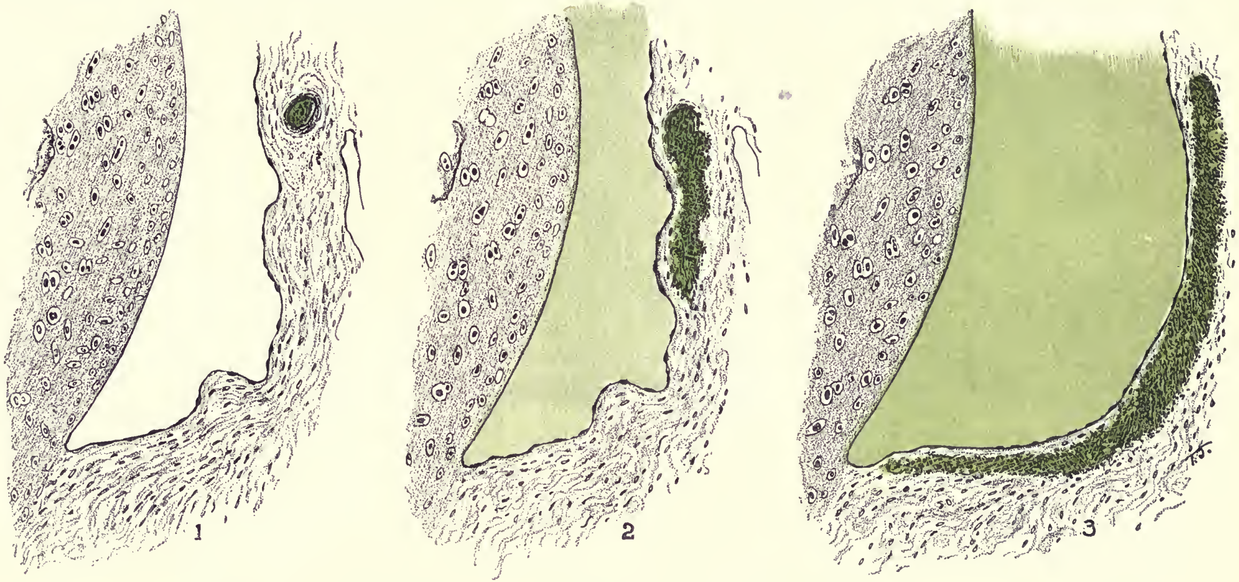

Fig. 29.—The histogenesis of a metastatic knee-joint infection. 1, A nidus of infection lodged in the subsynovial vascular layer of the capsule; 2, the focus spreading beneath the synovial membrane—early outpouring of fluid into the joint from irritation of synovia; 3, the march of the subsynovial infection; further distention of the joint with fluid.

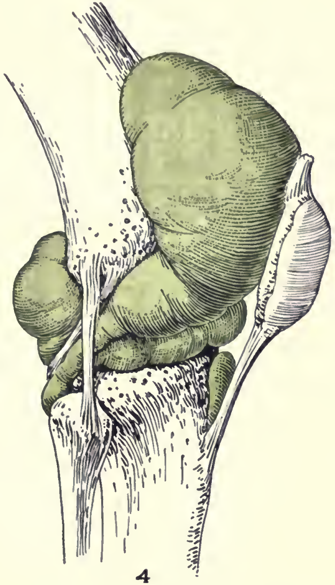

Fig. 30.—Distention of the capsule and associated bursæ with fluid; "floating" of the patella.

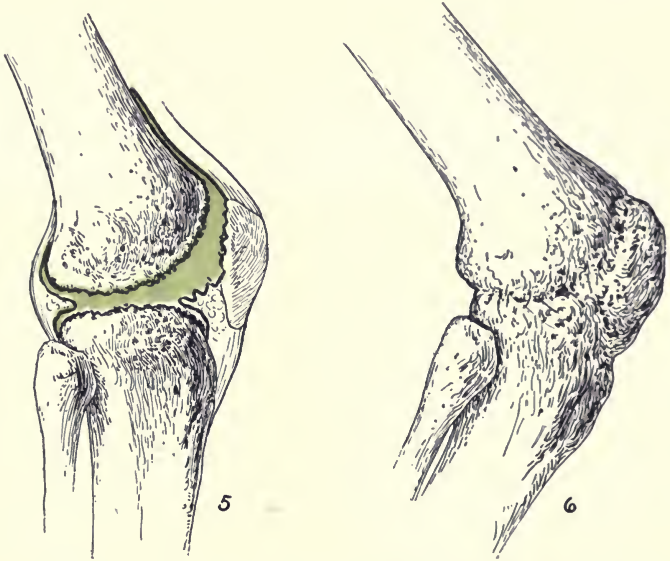

Fig. 31.—5, Erosion of articular cartilages and roughening of bone-ends; 6, the knee-joint as a tombstone to neglect: bony ankylosis in the vicious position of flexion.

uniformly good conditions, but unfortunate results under unfortunate technic.

The case before us is not a favorable one for obtaining a good result, because of the patient's youth and sex. With young lads you cannot obtain as good results in arthroplasty of the knee-joint as you can with women or girls, because the former have not enough fat to make thick interposing flaps: you have hard work in obtaining enough fascia even to cover the ends of the bones and to develop a hygroma. Secondly, this case is unfavorable because a drain had been inserted here on the exact site where I need normal fascia to fashion the interposing flap. Thirdly, it is unfavorable because the blood-supply to the skin and subcutaneous fat has been interfered with by the cicatricial deposit around the joint. Still, at the same time, conditions are favorable enough to justify an attempt to give him a movable joint.

OPERATION

In performing the work it is essential that there be no hand-contacting with the operative wound. This is a difficult matter when you realize the great amount of technic that is necessary here, and it is particularly difficult after we have been performing operations within the abdomen, where the hands are used freely in dealing with the tissues.

[U-shaped arthroplasty incision made.] There is little or no fatty tissue left here: it has been absorbed or destroyed. I must endeavor to save a little fat somewhere from which to make a cushion or pad. From the extent of that flap you can see why we occasionally have postoperative necrosis of the skin. . . . Now I am encountering that scar which I dislike so much. [Fashions interposing flap from outer side of joint.] I have little or no fat in this fascial flap, so that I am including some muscle-tissue from the vastus externus. [Prepares internal flap in similar manner, with base below.]

Now I have exposed the bony union between the patella and the external condyle of the femur, and must free the patella so as to expose fully the femorotibial line of synostosis. . . . Here I have to resect the external tuberosity of the tibia in order to obtain enough space in which to interpose the external flap. The adherence of the patella to the external condyle illustrates the observation I made many years ago, that bony ankylosis occurs at pressure-points alone, and that observation led to my insisting upon separation of the bone-surfaces during the active stage of the inflammatory process.

[With curved chisel, cuts through femorotibial synostosis.] Note that while separating these bones I am constantly endeavoring to maintain the normal convex conformation of the femur, and that the chisel is made to fit the curve of the condyle, thus aiding in maintaining its conformation. The internal condyle has a little broader curve than the external one has. . . . Now we have freed the external condyle, and I shall remove as much bone from the tibia as is necessary—in this case three-fourths of an inch—and I want to take it off at the midline, so as to permit space for interposition of the flap, and by the resulting concavoconvex fit we are reëstablishing the conformation of the joint along the normal anatomic lines.

The one structure at this juncture which we must carefully avoid injuring is the external popliteal nerve. . . . I am deepening the intercondyloid notch from this outer side. Many surgeons have failed in performing this arthroplasty operation because they have attempted to perform it merely from reading about it, whereas they should have first seen it executed, and tried it out on the cadaver again and again until they finally knew the technic, because there are so many points in the technic that are of great importance, and which, although minor details, yet, when observed, are conducive to good results.

[Synostosis on inner side of joint separated in similar manner.] There are the crucial ligaments; here is developed the intercondyloid ridge of the tibia. Now we are ready to interpose the flaps. The flap from the outer side goes in around the external condyle; the flap from the inner side goes in around the internal condyle, and both flaps overlap in the middle of the articular space, and are then stitched to available periosteum or remnants of fibrous capsule or ligaments on the tibia, both behind and in front, so that the joint-surface will be entirely covered. If these flaps survive, these bones cannot possibly grow together again, as our knowledge of the non-union of bones from the interposition of soft tissue has previously taught us.

[Fashions subpatellar flap and turns it in between patella and femur.] We are going to have a very good protection for the patella. The lateral ligaments have all been removed to secure a greater range of motion in the new joint and to prevent post-operative pain by removing the inflamed nerves in the ligaments. [Closes wound without drainage.]

RECAPITULATION

Let the record show that there was bony ankylosis between the patella and the external condyle and between the tibia and the femur at both tuberosities and condyles; that both areas of ankylosis were separated in the usual way, and that a sufficient amount of bone was resected to permit extension of the leg, the bone being removed from the posterior margin of the condyle a little more extensively than usual, so that full range of flexion without bony obstruction was secured; that next two good flaps were interposed and secured both before and behind; and finally that the wound was closed without drainage.

Let the record show also that the bleeding has almost entirely subsided, so that there was practically no oozing at the close of the operation.

POSTOPERATIVE COMMENTS

Those were just as good flaps as we have ever had, except that the amount of fat was less, but the amount of fibrous tissue was ample and in excess. All the tension on the skin sutures has been avoided and transferred to the subcutaneous tissues.

Now we shall watch for the development of a hematoma by dressing the wound at the end of forty-eight hours to see that there is no such blood-clot beneath the skin as I demonstrated to you yesterday. If there is a blood-clot, it will be aspirated every day until it has disappeared entirely. If a hematoma be allowed to remain *in situ* for any length of time, the blood-supply from the skin-flap becomes shut off, and the vitality of the skin-flap, which is essential in the final result, is impaired. If we are successful with the aseptic precautions, then we should obtain good results.

In the early days of joint work the only thing we feared was the removal of too many ligaments. Up to the present time we have never had a "loose" joint: if we have had any trouble at all with joint stability, the joints have been too tight, rather than too loose. I once saw a joint that was too loose after arthroplasty had been performed upon it elsewhere, but I think that too much bone was resected. The patient walked upon it very well, but it was wobbly.

Postscript.—The wound healed *per primam* and the case progressed favorably. No hematoma formed.

TALK ON THE TREATMENT OF INFECTIVE SYNOVIAL ARTHRITIS IN THE ACUTE STAGE

There is a law that no serous-lined surface can withstand exposure to the air for a protracted period without destruction of the endothelial layer and the inevitable agglutination, synechia, or adherence of the contacting synovial and bony surfaces. That is a law, which you cannot get away from, whether the infection involves the peritoneum, joint-synovial membrane, or pleura. While there are enough exceptions to the rule to lead one astray, yet ankylosis is the legitimate result of drainage of a joint, so that if you decide to incise a joint and insert drainage-tubes, you are planning for a result about as evil as you could possibly obtain. Instead of opening the joint and exposing it to the air, what should you do? *Aspirate!* Neutralize the infection in the joint-cavity by injecting one of the many antiseptics at your disposal, but preferably formalin in glycerin, because formalin produces a colossal polymorph-leukocytosis and coffer-dams the lymph-spaces. This polymorph-leukocytosis is greater than that evoked by any other material with the exception of turpentine, but the extent of the inflammatory action of turpentine cannot be limited, and therefore the use of turpentine is out of the question, and we must use the next best remedy. If the joint be widely infected, instead of aspirating you may incise and irrigate it, and then sew it up without drainage, inject formalin in glycerin, and then keep aspirating and injecting. If the fever persists, re-inject the joint, and, as long as the tension keeps up, aspirate it every day.

In the case of a phlegmon involving, for example, the forearm, what is causing the destruction of tissue? It is the tension of the pus content, which is removed by merely incising the phlegmon. Once we learn to apply the same principle to an infected joint—to get the tension off and keep it off—we shall not have so many wrecked joints. In the case of the forearm there is but one cause of tension—the accumulation of pus with no outlet. In the case of a joint there are two causes of tension, first the accumulation of pus (Fig. 30, p. 176) and secondly the intra-articular pressure exerted by the muscles contracting in an attempt to immobilize the painful infected joint. To overcome the intra-articular pressure due to muscular contractions, you need but apply traction; and to overcome the tension of the pus-products, aspirate, and after aspiration neutralize the infection by the formalin injection.

I am now speaking of the metastatic infections in the joints: such an injury as a compound fracture into the knee-joint is an entirely different proposition. In the type of injury to the knee-joint which is so common in Chicago in the stock-yards district, where, while handling beef with a large hook, a workman accidentally sticks his hook into his knee-joint, if he comes to you that same night with fever, do not insert a drainage-tube, but inject the knee-joint with formalin at once, so as to coffer-dam the lymph-spaces. You rarely need give more than three injections, and while six or eight aspirations may be necessary, yet by this method you can carry the case through the course of the infection without ankylosis and without danger to the patient.

TUBERCULOSIS OF KNEE-JOINT—RESECTION BY CONCAVOCONVEX METHOD.—SUBPATELLAR ARTHROPLASTY

Summary: Clinical history of patient; comments—analysis of history; choice of operation; cause of kyphosis of spine; mode of healing of tuberculous *vs.* metastatic arthritis; operation—exposure of joint by goblet-shaped skin and **S**-shaped osseo-aponeurotic incision; tuberculosis found active in synovial membrane, contraindicating arthroplasty; tuberculous synovial membrane excised; healed tuberculous process found in external condyle of femur; advantages of the concavoconvex mode of resection (Murphy) over the classic square method; abduction of leg after resection is undesirable, but no harm in slight adduction; subpatellar arthroplasty; closure of incision; recapitulation.

CLINICAL HISTORY OF PATIENT

The patient, a male twenty-four years of age, was admitted to Mercy Hospital May 2, 1915. During the past four years he has been suffering from pyorrhœa alveolaris. Two years ago he had a "soft" chancre.

Six years ago, in June, 1909, while scuffling, the patient's opponent grabbed the right knee from the outer side and pushed it inward, the leg being fully extended, since the patient was standing. He immediately heard something crack, and during the next ten minutes the knee pained considerably. After the incident he was able to walk without difficulty: at no time has the joint become locked. Shortly afterward, however, the knee began to swell, and it remained moderately swollen for a year. At times after the patient had taken a long walk, or stood for a long time, the knee began to ache.

From June, 1910, until a year ago, the patient was able to walk, but noticed that the knee-joint was slowly but surely becoming stiff, and that it ached at times.

Nearly two years ago, in November, 1913, the patient's back in the lower thoracic region became painful on bending forward. A physician put him to bed and applied a plaster-of-Paris jacket, which was retained four days, when a leather jacket was substituted for it. The patient remained in bed the greater part of a year, and while in bed, noticed that his knee-joint was getting weaker and stiffer, but that he could still bend it.

In 1914 the patient left his bed and remained up. His back was now much less painful. A circular gypsum case was applied to the slightly flexed knee and was retained for three months: upon removing it six weeks ago the patient could not bend the knee, which pained on the slightest movement of the leg. To prevent motion the knee was splinted in a wire cage.

During the last two months the back did not pain, but the patient still wears the leather jacket. At present the knee is stiff, moderately swollen, and painful when the leg is moved.

On June 10, 1915, a tuberculin test was positive.

COMMENTS

Dr. Murphy (June 12, 1915): This patient's history reveals first the history of the original trauma, and finally, after six years of increasing incapacity, almost complete ankylosis of the knee-joint.

While exploring this knee-joint I shall decide whether arthroplasty or resection is indicated: if the latter, I shall perform the operation in such a manner that some time in the future I may also be able to perform arthroplasty. Now if this tuberculous process be active, I must not perform arthroplasty; but if it be quiescent, then I shall perform that operation.

OPERATION

There is the patella and here are the quadriceps expansions on each side. [Exposes joint by goblet-shaped incision of skin and S-shaped of osseo-aponeurotic anterior wall, as for concavoconvex resection. For illustrations of steps of operation consult vol. iv, October, 1915, pp. 1000–1003, Figs. 253–259.]

There is the fibrous capsule: I shall preserve it in case I find the joint in sufficiently good condition to perform arthroplasty. There is the deep infrapatellar fatty bursa: infection occasionally involves it (Fig. 23, p. 163), but fortunately it does not communicate with the synovial cavity of the joint, being separated from it by the plica synovialis patellaris.

Let the record show that the tuberculous process is now active in the synovial membrane—too active to permit of arthroplasty—and that we shall aim to produce bony ankylosis

If we performed arthroplasty in the face of this active tuberculous process, we would have tuberculous infection of the interposing flaps, and thus an evil result. I am removing the tuberculous synovial membrane, and wish it preserved for examination. We are going to clean the joint out thoroughly. The cartilage has been lifted up by the tuberculous process beneath it: tuberculosis always destroys the cartilage in that way. You can see how extensively diseased this joint is. There is one of the places that it is difficult to free—the area around the crucial ligaments; but these ligaments must be freed to enable me to open the joint to the fullest extent, thereby affording better access to its remotest corners. . . . I am freeing all that synovial membrane. . . . We mop the joint with 5 per cent. phenol, which is superior to all other antiseptics.

There are the cavities of a healed tuberculous process in the external condyle of the femur, indicating that the infection did not begin originally as a synovial, but as an osseous, tuberculosis—the bone being by far the commoner site of lodgment of *B. tuberculosis* in adults. This disease does not attack fat, nor the white fibrous tissue of the joint-capsule. The process invaded by contiguity the synovial membrane, where it is now active.

In performing the resection I am maintaining the conformation of both bone-ends—the convexity of the femoral and the concavity of the tibial end—for three reasons: first, to prevent the resected ends slipping past each other; secondly, to produce a uniform contacting of the entire bony surface, regardless of the degree of angulation of the leg to the thigh, and thirdly, to provide suitably shaped articular surfaces for the reëstablishment of a movable nearthrosis at a later operation. Formerly, in resecting the knee-joint, we cut the bone-ends square off, and the result was that they slipped past each other, or angulated upon the slightest degree of flexion or extension, abduction or adduction, and therefore required nails and wires to hold them in apposition. Ordinarily we shave off the articular surface with the Gigli saw, but the saw is out of order today, so that we must employ the chisel. We can work as well with the chisel as with the saw, but with the former it takes a little longer. This shaving down of the articular surfaces is what we used to call the atypical method of resection. We must shave off a little more bone from the internal condyle to prevent adduction of the leg, which is undesirable; there is no harm in a slight degree of adduction, however. .

We have now made a concavoconvex resection: the convex end of the femur fits perfectly into the concave end of the tibia, and a fine apposition is the result. With such a curve, no matter in what direction the tibia is moved upon the femur, the bone-ends always contact over all their surface.

To maintain the mobility of the patella I shall interpose two flaps, so arranged that the sesamoid bone will not contact with the femur. I shall also deepen the intercondyloid notch, so as to prevent the mobilized patella slipping laterally. [Interposes fascia-fat flaps between patella and femur.

Now we are ready to suture the inner cut half of the ligamentum patellæ where it was detached as part of the procedure by which the joint was exposed. . . . [Apposes halves of patella where split in midline.] . . . . You understand how the more the quadriceps muscle contracts the closer these longitudinally split patellar halves contact with each other, thus differing entirely from the sequence of a transverse division, but resembling the *modus operandi* of the vertical rectus abdominis incision. Next I reattach the quadriceps tendon to the top of the outer half of the patella. . . . [Closes skin-wound.]

As sequences of this operation we expect bony ankylosis of the tibia and femur and a movable patella—conditions which are suitable for a subsequent arthroplasty.

RECAPITULATION

Let the record show that after making the goblet-shaped skin-incision the outer half of the quadriceps tendon was detached from the upper margin of the outer half of the patella, and the bony patella was next split through its middle on a line parallel with the long axis of the leg, after which the inner half of the ligamentum patellæ was divided; that after exposure of the joint-cavity it was found that the tuberculous process began in the external condyle of the femur, whence it extended into the joint; that this ancient focus of tuberculosis was healed, but a recent active tuberculous process was found in the synovial membrane; that we removed first all portions of the synovial membrane that were involved in the process, and next resected the articular end of the femur, maintaining its normal convex conformation by working along a curve at a depth of ¼ inch below and parallel with the articular cartilage; that next we excavated the upper articular surface of the tibia, the depth of bone removed ranging from ½ inch in the middle to ⅛ inch at the anterior and posterior margins, so that a concavity was produced whose arc exactly corresponded with that of the convexity of the femur; that we next interposed fat-and-fascia flaps beneath the patella to prevent its adhering to the deepened patellar fossa of the femur; that in closing the incision we readjusted the severed quadriceps tendon, the halves of the divided patella, and the severed ligamentum patellæ, the cut surfaces of these parts fitting accurately to each other for their entire distance; that we sutured the expansion of the quadriceps tendon upon the anterior surface of the patella so as to get a firmer adjustment; and finally that the skin-edges were apposed without drainage being inserted.

Postscript.—There was complete primary union, both of the osseous and soft parts. The patient has a solid serviceable limb.

[Additional cases of tuberculosis of knee-joint have been previously published as follows: vol. i, August, 1912, 607–619; vol. ii, February, 1913, 83–98—talk on treatment of tuberculous joints; vol. iv, October, 1915, 993–1006—illustrations of resection by concavoconvex method.]

HALLUX RIGIDUS—RESECTION AND ARTHROPLASTY; PES PLANUS—ELONGATION OF PERONEAL TENDONS

Summary: Clinical history of patient; examination—skiagram shows healed tuberculosis of knee; comments—*hallux rigidus:* its nature and treatment; scheme of operation; operation—tenotomy, capsulotomy, sesamoidectomy, arthroplasty, tenoplasty; osteoarthritis of metatarsal head with villus formation; importance of removing sesamoid in this operation; operation for pes planus—elongation of peroneus longus and brevis tendons; arthrodesis of astragaloscaphoid joint for flatfoot too radical in the average case.

CLINICAL HISTORY OF PATIENT

The patient, a female twenty-one years of age, was admitted to Mercy Hospital November 11, 1915. The family history reveals that one aunt died of pulmonary tuberculosis, and that at the time of her death this aunt was living with the patient.

When the patient was two years of age there appeared both pain and swelling in the right knee, but abscess- and sinus-formation did not take place. By way of treatment the patient used crutches, wore a gypsum case, and often took to bed during the succeeding thirteen years. For the last six years the knee-joint has caused no further trouble. At present there is a range of 15 degrees of motion in the joint.

Twelve years ago, in 1903, there appeared a dull pain in the great toe on the right side, and this pain has usually been present since then. There is limitation of motion in the metatarsophalangeal joint. Swelling has never been present.

Examination by Dr. Murphy (November 8, 1915).—The skiagram of the knee-joint shows that the internal tuberosity of the tibia has been extensively diseased from a tuberculous process. The excursion of the patella is limited, but the bone itself is not united with the femur.

COMMENTS

Dr. Murphy (November 13, 1915): The tuberculous process in the knee-joint has undergone repair in a remarkable manner. We have been endeavoring to extend the range of flexion, and by manipulations the adhesions in the joint have yielded considerably. We can now flex it to beyond 90 degrees. [To intern.] What is the trouble with that toe?

Intern: It is the seat of either fibrous or bony ankylosis.

Dr. Murphy: No; it is *hallux rigidus*, or rigid toe—a classic lesion which is described in text-books: the toe cannot be extended or flexed. Owing to contracture of the dorsal portion of the joint-capsule and of the extensor tendon of the joint the patient cannot flex the toe. Hallux rigidus is a typical and classic condition. There is also a painful callus.

The operative treatment of the toe-lesion offers a difficult problem. Merely to divide the tendon (*tenotomy*) or the capsule (*capsulotomy*) will not suffice: permanent relief will be obtained only by resecting the head of the metatarsal bone, and then performing arthroplasty by turning in the bursal capsule as an interposing flap to cover the cut end of the bone, and at the close of the operation by elongating the extensor hallucis proprius tendon. The left foot is the seat of *pes planus*. These sufferers often request that you amputate the anterior portion of the foot (*antetarsus*), but, of course, you must never do that.

OPERATION

[Curved incision with convexity outward made along extensor tendon (Fig. 32, 1); tissues retracted, exposing tendon (Fig. 32, 2).] There is the extensor hallucis proprius tendon: we shall elongate it so as to avoid postoperative tension upon the interposing flap. [Z-shaped division of tendon, reflection of ends, and longitudinal incision through capsule (Fig. 32, 3).] There is the head of the metatarsal bone covered internally by the bursal capsule: we shall save the latter and utilize it as an interposing flap for the nearthrosis, as first suggested by Charles H. Mayo. From an artistic as well as a technical standpoint this is the most interesting case of the day.

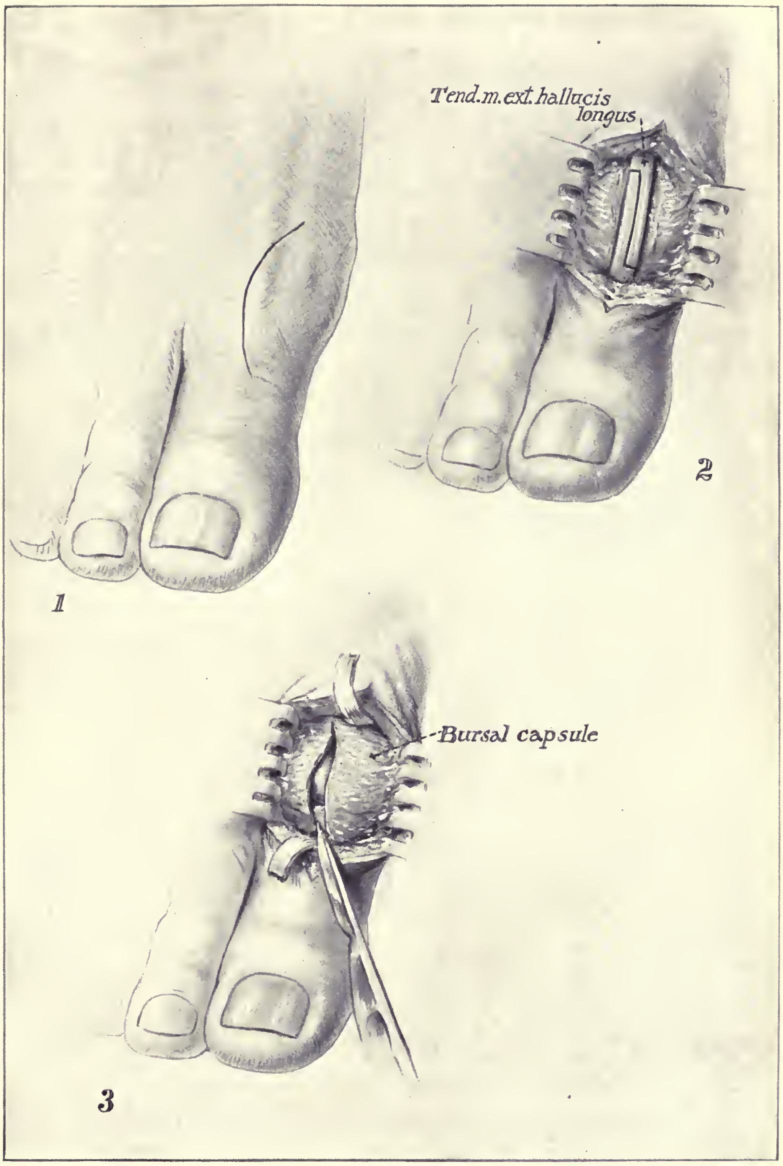

Fig. 32.—1, Curved incision, convex externally, over extensor hallucis proprius tendon; 2, retraction of wound-edges, exposure of tendon, and incision of same preparatory to its elongation; 3, retraction of tendon-ends, exposure of bursal capsule on inner side of operative field; knife has completed longitudinal incision through articular capsule. (Sketches made at operating-table.)

The joint is virtually wrecked as a sequence of the chronic inflammatory condition. [Resects metatarsal head (Fig. 33, 4, 5).] Note these inflammatory villi, to which I called your attention earlier in the morning (Fig. 33, 6): they have been repeatedly traumatized by being pinched in the distorted joint in walking. There is one of the sesamoid bones, deep in the operative field (Fig. 33, 6, *A*): one or other of these bones occasionally gives rise to great pain on account of its proximity to the diseased head of the metatarsal; and if you leave the sesamoid behind in these cases it may cause intolerable pain in walking. I am freeing that sesamoid from its bed in the flexor tendons, preparatory to its removal. [Excises sesamoid in question.]

I am now turning the bursal capsule in between the sawn neck of the metatarsal bone and the phalanx, so as to cover over the freshened end of the metatarsal bone and form an interposing flap for the nearthrosis (Fig. 33, 7). [Tacks interposing flap *in situ* with a few interrupted catgut sutures.] In closing the wound we first suture the tendon, which we incised in a manner that would permit of its elongation at this stage of the operation. [Closes skin-wound without the use of drainage.]

COMMENTS ON PES PLANUS

There is also a spastic condition of the peroneus longus and brevis muscles of the left foot, which has been a factor in producing the pes planus on that side. A flat foot is always abducted into *valgus* position, and the inner longitudinal arch is depressed. The tendon of the peroneus longus passes downward behind the fibular malleolus, and crosses the plantar aspect of the foot obliquely to insert into the base of the metatarsal bone of the great toe: its action is to aid in everting the foot. The indication to be met here is to elongate the peroneus longus and brevis tendons, thereby lessening the degree of abduction of the foot.

Of the various operations which have been suggested for the relief of flat foot one of the most effectual is that of elongation of the peroneus longus and brevis tendons: arthrodesis of the head of the astragalus and the articular surface of the scaphoid, with a view to securing bony union by synostosis of the cut bone-sur-

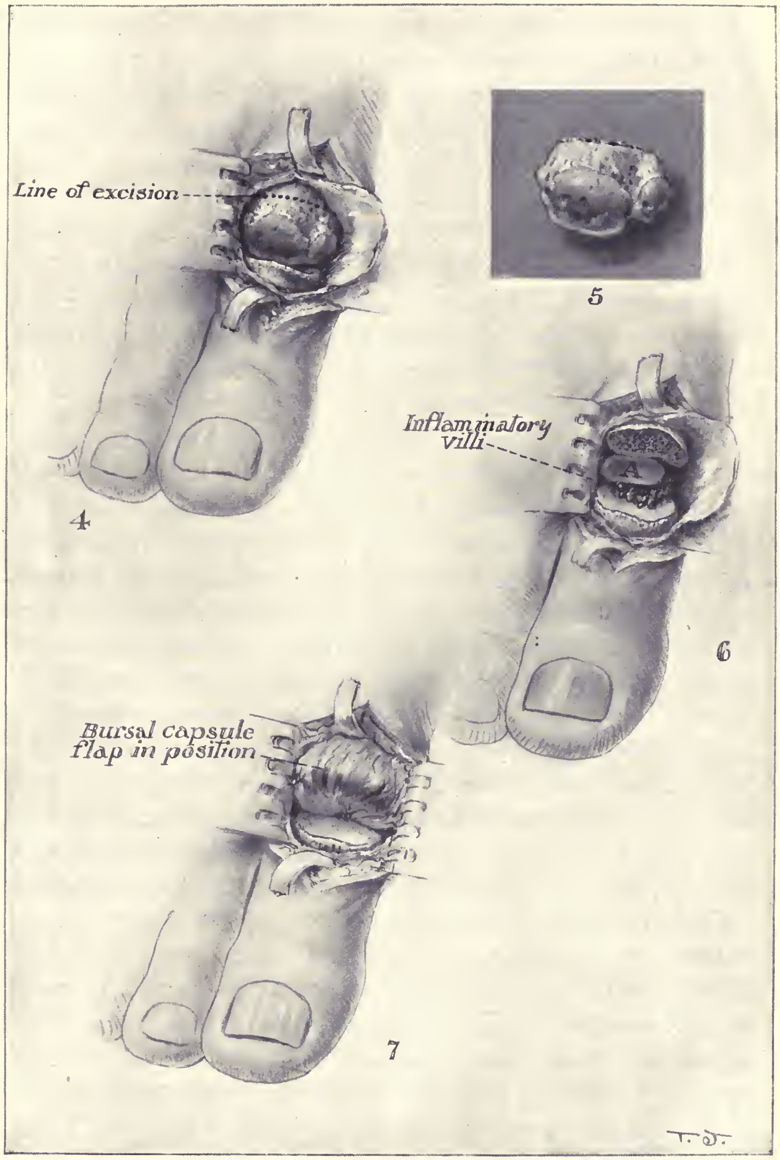

Fig. 33.—4, Retraction of articular with bursal capsule internally, exposure of joint, line for resection of metatarsal head; 5, resected head deformed from osteoarthritic hyperplasia; 6, floor of cavity left remaining after removal of head—behind, at *A*, is sesamoid, which was excised later, while before are inflammatory villi; 7, bursal capsule in position as interposing flap, arranged about sawn end of metatarsal and tacked peripherally. (Sketches made at operating-table.)

faces, is a questionable procedure; and while it may be executed in superlatively bad cases and with good results, yet it is not the proper operation for the *average* case of flat foot, for it is a more extensive procedure than conditions usually warrant, resulting in loss of the elasticity of the longitudinal arch of the foot.

PES PLANUS OPERATION

[Vertical incision over course of peroneal tendons behind fibular malleolus.] The incision of the skin must not be placed directly over the bony malleolus, because the resulting scar will be exposed to direct pressure. . . . See how nicely the peroneal tendons come into the field! Here is the tendon of the brevis as it passes down under shelter of the fibular malleolus, while just behind the brevis, and separated by it from the malleolus, is the longus tendon. I wish to elongate these tendons to the extent of 3 inches—1½ inches to be contributed by each severed tendon-end, so that there will be no longer any tension. [Severs each tendon in turn, just as in dealing with that of extensor hallucis proprius above, and sutures elongated ends with chromic gut (for illustrated technic of the method of tenoplasty *vide* vol. iv, October, 1915, Figs. 248, 249, 250, pp. 986–987).]

At first the elongated tendons will be relaxed, but as their muscle-bellies recover their tonus and contract sufficiently, the tendons will finally become shortened enough to resume the support of the foot in its new relationship. [Sutures openings in tendon-sheaths and closes wound without inserting drainage.]

The foot will be dressed in a gypsum case, which will be retained about four weeks.

Postscript (*December 21, 1915*).—The patient is still in hospital. The wounds healed *per primam* throughout.

THE CLINICS
Volume V OF Number 2
JOHN B. MURPHY*

A TALK ON THE SURGERY OF TENDONS AND TENDON-SHEATHS

SYNOPSIS

I. The Newer Anatomy
II. Tendons: Rupture
III. Luxation
IV. Tumors
V. Wounds and Infections
VI. Transference
VII. The Tendon-Sheaths: Inflammations
VIII. Tumors

I. THE NEWER ANATOMY

THE investigations of Mayer show that the *sheath* is interposed between fascia and tendon, where the tendon changes its direction (Fig. 34). It does not, as usually maintained, give the tendon an increased range of motion, since the tendon glides as freely above the sheath as within it. Above and below the sheath, between the fascia and the tendon, is interposed the *paratenon*, a loose, vascular, fatty connective tissue rich in elastic fibers. The paratenon is prolonged downward into the sheath as a tongue-like fold, the *plica duplicata*, so termed to distinguish it from another type of reflection usually found at the lower pole of the sheath, the *plica simplex*. The *mesotenon*, continuous with the paratenon, connects the tendon with the floor of the sheath and transmits blood-vessels to the tendon. It expands on the surface of the tendon, forming a delicate, almost microscopic layer, the *epitenon*. Paratenon, epitenon, and mesotenon constitute the *esotenon* as opposed to the *endotenon*, the connective-tissue strands within the tendon. For all the connective-tissue structures associated with the tendon the old term *peritenon* may be employed.

The mesotenon may not inaptly be compared with the mesentery: it suspends the tendon from the posterior wall of the sheath just as the latter suspends the gut from the posterior wall of the abdomen. Furthermore, in a similar manner it conveys blood-vessels to the tendon, which even form vascular arcades. The mesotenon may be absent, however: thus, in the extensors of the foot and toes it is constant and well developed; of the flexors the tibialis posticus is always without it, the flexor hallucis longus in 70 per cent., and the flexor digitorum longus in 50 per cent. When the mesotenon is absent, the blood-vessels are conveyed through the vincula at the ends of the sheath.

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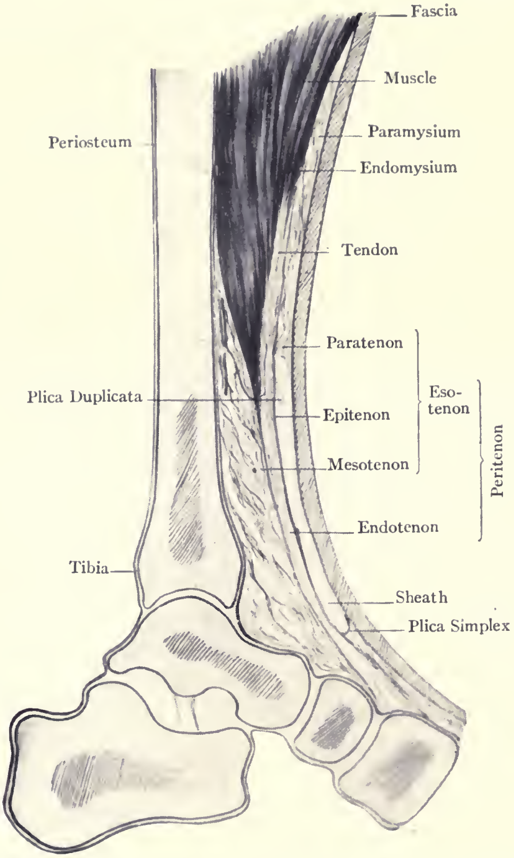

Fig. 34.—Ideal longitudinal section through the tendon of the tibialis anticus muscle and the adjacent structures (Mayer).

The *blood-vessels* of a tendon, according to Mayer, are derived from three main sources: (1) From muscular branches; (2) from vessels running in the surrounding connective tissue, paratenon, mesotenon, and the vincula; (3) from vessels of the bone and periosteum near the point of insertion of the tendon. Except near its friction-surface, where blood-vessels are absent, the latter are numerous throughout the tendon; but, according to Quekett ("*Lectures on Histology*," 1852, vol. i, 132), the number of vessels in a tendon is very small as compared with those of the muscle to which it is attached, and in all injected specimens the precise point where the muscle ends and the tendon begins is readily perceptible even to the naked eye, not only by the diminished vascularity of the latter, but also by the difference in the arrangement of its vessels.

The *lymph-vessels* form a rich plexus on the epitenon.

The *sensory nerves* begin in arborizations termed Golgi's tendon spindles, or in Vater-Pacinian bodies; they are found in all tendons, and serve to transmit the sensation of tension, being concerned with coördination of movement. Vasomotor nerves supply the arteries of the tendon.

Structurally, tendon consists of parallel bundles of white fibrous tissue—the strongest tissue in the body, as the following table shows:

Variety of Connective Tissue	Weight Borne by a Strip 1 Sq. Mm. in Cross-Section Before Breaking
Hyaline cartilage	1440 grams
Elastic cartilage	1760 "
Fibrocartilage	2300 "
Yellow elastic	4040 " (length increased 65 per cent.)
White fibrous	8940 "

There is also a minimal amount of yellow elastic tissue in the tendon itself, but much more in the paratenon.

The fibrous sheath partitions the tendon by means of septa, which enter through the hilum and convey the blood- and lymph-vessels (endotenon). The sheath itself is lined by flattened mesenchymal epithelium (endothelium) and contains viscid fluid.

The practical application of these facts will be gradually unfolded during the course of the talk. The rôle which tendons play

A SERIES OF SIX SKETCHES SHOWING LIMITS OF EXCURSION OF TENDONS ABOUT WRIST DURING CERTAIN MOVEMENTS OF HAND AND OF FINGERS

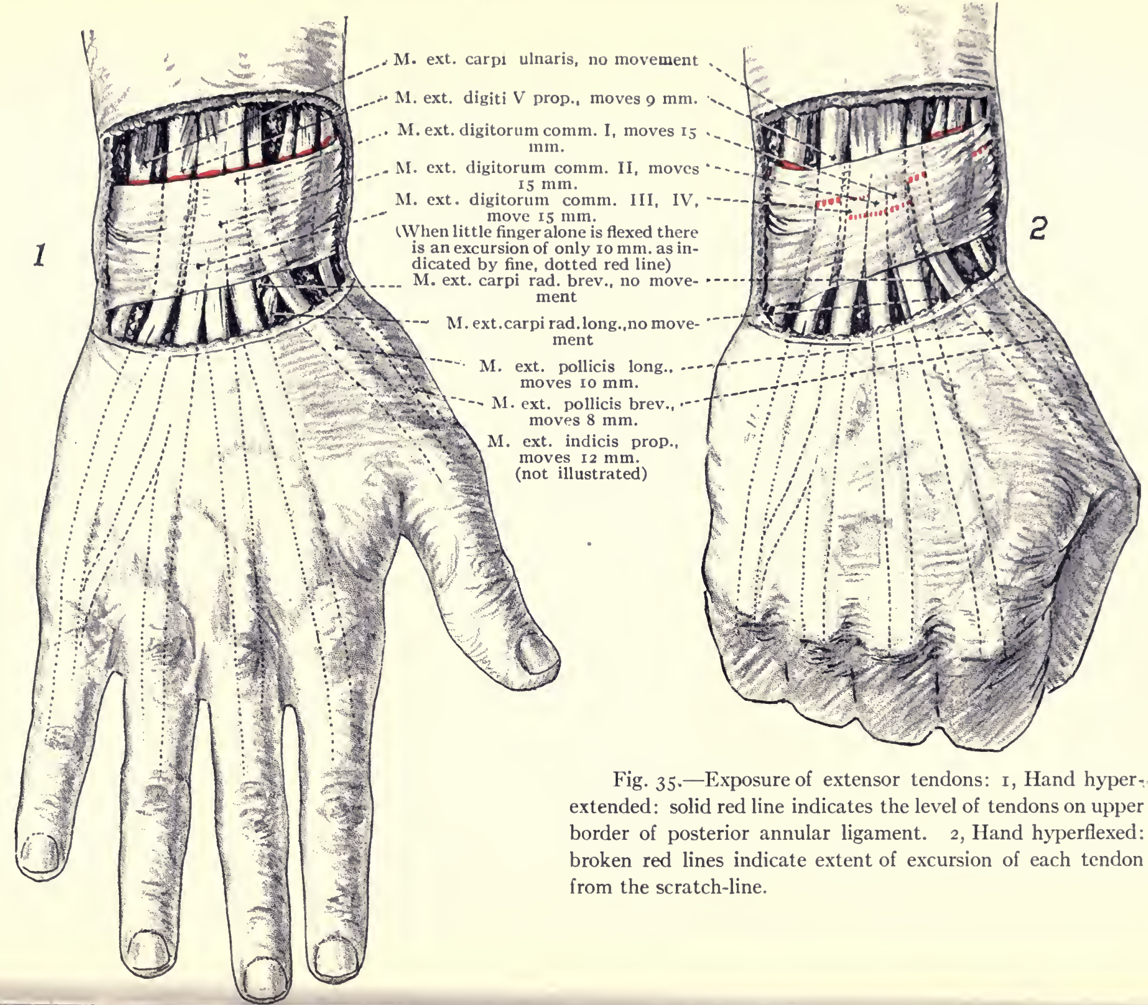
1
2
M. ext. carpi ulnaris, no movement
M. ext. digiti V prop., moves 9 mm.
M. ext. digitorum comm. I, moves 15 mm.
M. ext. digitorum comm. II, moves 15 mm.
M. ext. digitorum comm. III, IV, move 15 mm.
(When little finger alone is flexed there is an excursion of only 10 mm. as indicated by fine, dotted red line)
M. ext. carpi rad. brev., no movement
M. ext. carpi rad. long., no movement
M. ext. pollicis long., moves 10 mm.
M. ext. pollicis brev., moves 8 mm.
M. ext. indicis prop., moves 12 mm. (not illustrated)

Fig. 35.—Exposure of extensor tendons: 1, Hand hyperextended: solid red line indicates the level of tendons on upper border of posterior annular ligament. 2, Hand hyperflexed: broken red lines indicate extent of excursion of each tendon from the scratch-line.

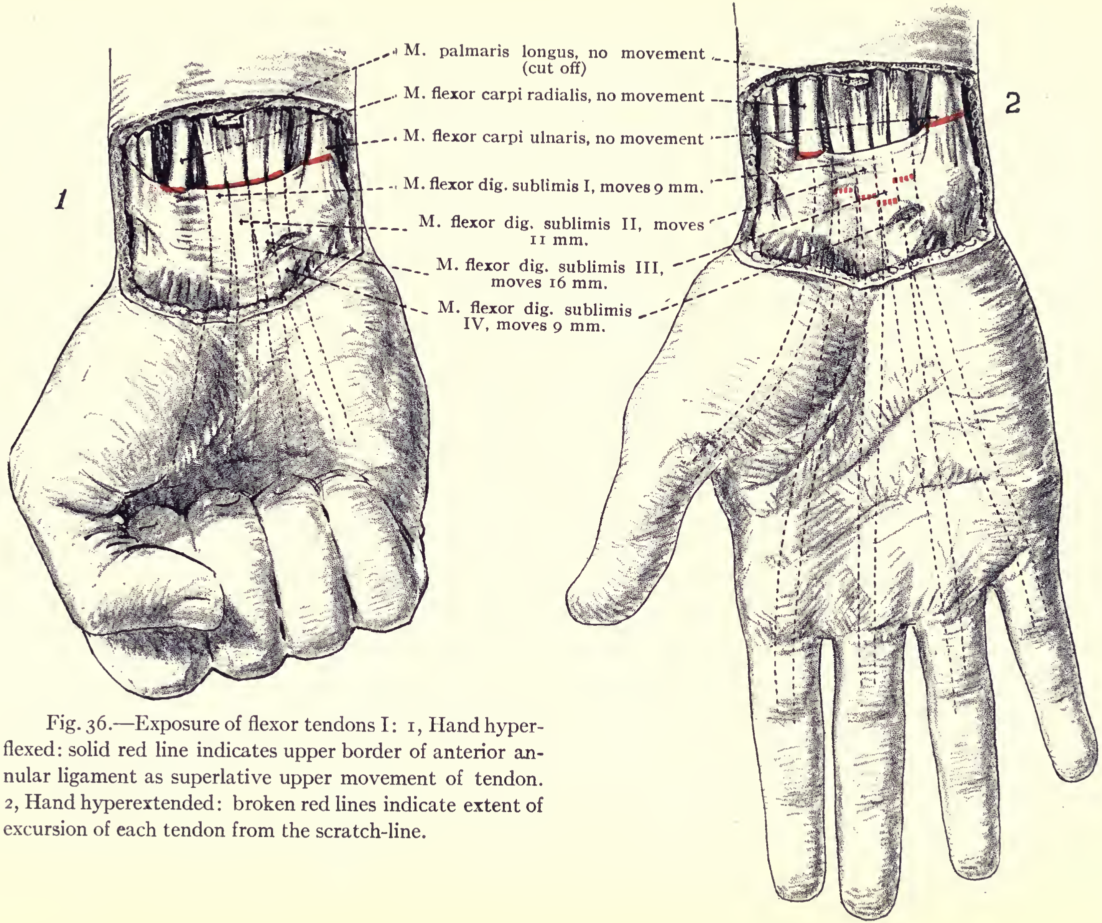
1
2
M. palmaris longus, no movement (cut off)
M. flexor carpi radialis, no movement
M. flexor carpi ulnaris, no movement
M. flexor dig. sublimis I, moves 9 mm.
M. flexor dig. sublimis II, moves 11 mm.
M. flexor dig. sublimis III, moves 16 mm.
M. flexor dig. sublimis IV, moves 9 mm.

Fig. 36.—Exposure of flexor tendons I: 1, Hand hyperflexed: solid red line indicates upper border of anterior annular ligament as superlative upper movement of tendon. 2, Hand hyperextended: broken red lines indicate extent of excursion of each tendon from the scratch-line.

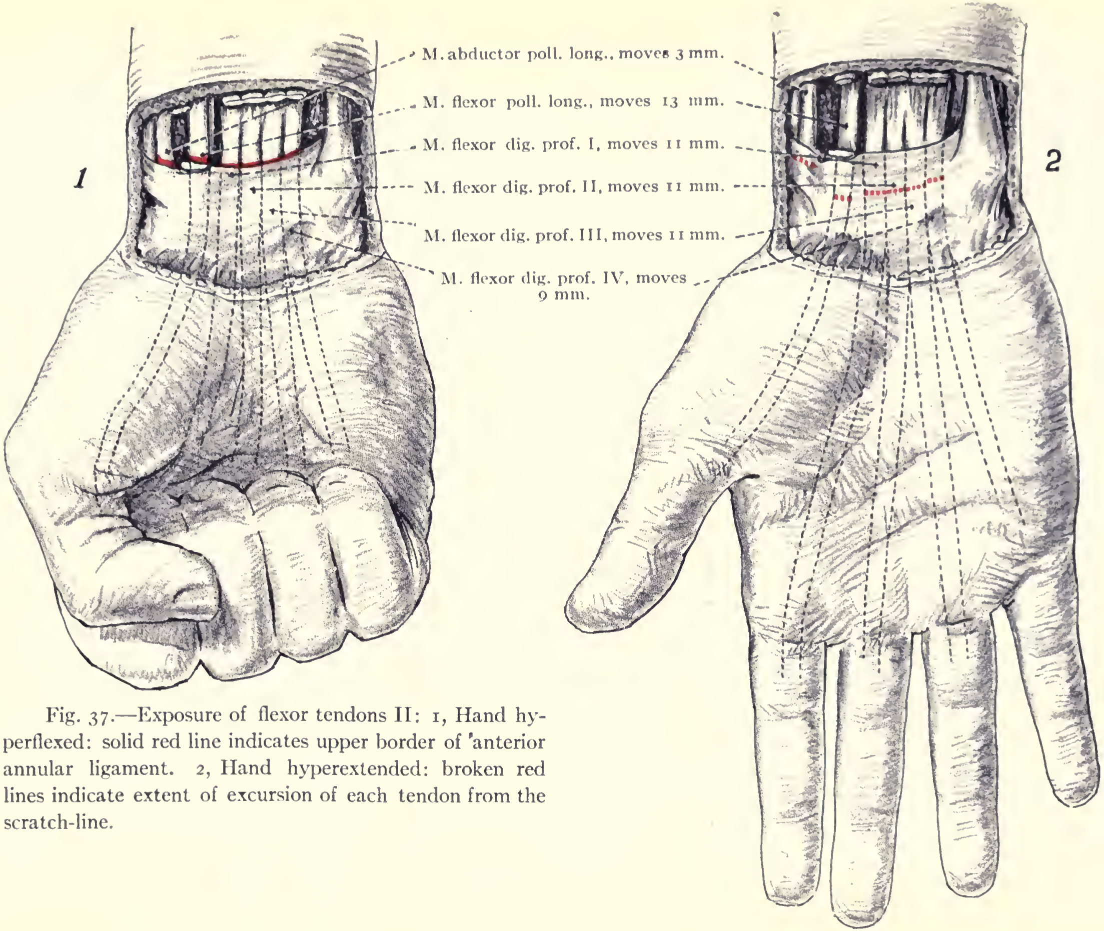
1
2
M. abductor poll. long., moves 3 mm.
M. flexor poll. long., moves 13 mm.
M. flexor dig. prof. I, moves 11 mm.
M. flexor dig. prof. II, moves 11 mm.
M. flexor dig. prof. III, moves 11 mm.
M. flexor dig. prof. IV, moves 9 mm.

Fig. 37.—Exposure of flexor tendons II: 1, Hand hyperflexed: solid red line indicates upper border of anterior annular ligament. 2, Hand hyperextended: broken red lines indicate extent of excursion of each tendon from the scratch-line.

as part and parcel of the general motor apparatus must be constantly borne in mind.

II. TENDONS: RUPTURE

Despite the vaunted strength of tendons, they rupture at times when subjected to exceptional stress. More often, however, the ruptured tendon has been previously weakened by disease. Thus, a preceding tenosynovitis may produce infiltration of the tendon with serum (Volkmann), the tendon may be partly worn and raveled in hydrops of the sheath, or reduced to a third or a quarter of its diameter in hydrops with lipomatous degeneration of the sheath (Witzel). The trophic disturbances in tabes and syringomyelia are weakening factors in other cases; tuberculosis in still others. At the time of rupture a snap may be felt and even heard, but the chief symptom is the loss of function in the muscle the tendon of which is ruptured. The situation of the rupture can be detected by the finger, feeling the step-like gap between the ends of the tendon, as after tenotomy, the interval being filled with a soft clot of blood, which may impart a crackling sensation to the finger.

Shortly after recovery from traumatic tenosynovitis the tendon of the extensor pollicis longus may be ruptured from a slight accident. A not infrequent result of the finger-tip being actively or passively struck—typically in the act of catching a baseball—is the sudden appearance of *mallet-finger* (drop-finger) from avulsion of the extensor digiti from its insertion into the dorsum of the base of the ungual phalanx: the resulting flexion-deformity of the latter varies from an obtuse to a right angle. If seen early, splinting in hyperextension may cure; but in case of failure and if seen later, the tendon should be reattached to the phalangeal periosteum by suture.

Another tendon not uncommonly ruptured when present is that of the vestigial plantaris muscle. The longest tendon in the body, it may rupture when subjected to the stress incident upon sudden elevation of the os calcis, such as occurs in sports (*lawn-tennis leg*), and more commonly in stepping down from the curb into the street or from one rung of a ladder to another. The pathognomonic symptom of this injury is the sensation of the sting of a bullet or of a whipcord, whence the term *coup de fouet.* A case occurred in a colored laborer who, while carrying a hod down steps, turned about to see "who hit him in the calf with a stone," and, happening to see a stone nearby, enlisted some bystanders in his cause and spent quite some time in a futile search for the imaginary miscreant. Thus, the history is so characteristic that, if one is alert, a correct diagnosis is certain. By way of treatment, strapping of the calf or the application of a firm muslin spica for a few days usually suffices.

Another rupture that may be due to a similar mechanism is that of the tendo Achillis—the proverbial weak spot in mythology. This injury should be treated by immobilizing the foot at a right angle with the leg in a plaster-of-Paris bandage for six weeks: suture is the alternative treatment when conditions warrant. The lesion differs from that produced by tenotomy in that the tendon-ends are ragged instead of cleancut; the inflammatory reaction is greater; the tendon-sheath is more widely opened, and the tendon is probably weakened by previous disease.

Rupture of the usually diseased biceps flexor cubiti muscle is much commoner than rupture of its long glenoid tendon. Owing to the function of the latter as an accessory ligament, when it is ruptured, the head of the humerus escapes slightly forward and upward, and Hüter's sign is present (flexion of supinated forearm weaker than that of pronated forearm). The diagnosis is easy when based on an accurate history, and when the possibility of the condition occurring is borne in mind and dovetailed with the history. Tenorrhaphy is the treatment of choice, but when operation is contraindicated, postural treatment is to be employed, namely, complete relaxation of the muscle by dressing the limb with the forearm supinated and flexed and the arm abducted.

Rupture of the tendon of the quadriceps extensor or of the ligamentum patellæ is, from the practical standpoint, not essentially different from fracture of the sesamoid patella; rupture of its homologue, the triceps extensor cubiti, is a rarer lesion.

In the operative treatment of tendon-rupture it is advisable to observe the principles of coffer-damming, which have been so frequently inculcated in the Clinics, by awaiting the subsidence of the primary inflammatory reaction (ninth to fifteenth day), lest the fresh blood-clot should become infected by premature operative exposure.

III. LUXATION OF TENDONS

When changing their direction and rounding bony prominences, tendons are prevented from straightening their curves during muscular contraction by stout fibrous sheaths and ligaments. When these retaining structures are torn from trauma or disintegrated from disease, their retained tendon is liable to become displaced during contraction of the muscle-belly. Based upon this mechanism, it is not difficult to figure out what tendons are most frequently luxated. Thus, in the upper extremity the long head of the biceps is not infrequently displaced from its groove on the head of the humerus between the tuberosities, permitting the head to pass forward for the reason stated above, and resulting in "subluxation" of the humerus. The extensor tendons passing over the dorsum of the wrist and the flexor carpi ulnaris tendon may also be luxated.

In the lower extremity, as would be expected, the peroneus brevis and the peroneus longus tendons are most frequently luxated from their position behind the fibular malleolus until they override the malleolus: in a similar manner the tendon of the tibialis posticus may be forced out from behind the tibial malleolus. In either case the malleolus may be congenitally low. The tendon of the quadriceps extensor, carrying with it the patella, and the sartorius, may also be displaced.

The diagnosis is based upon the history of injury or the presence of joint disease, the curtailment of the action of the muscle, the absence of the tendon from its normal situation, and its palpable presence elsewhere—especially upon muscular contraction. In the case of joint-disease, the luxated tendon may be destroyed.

The operative treatment consists of suturing the freshened edges of the sheath and ligament, of suturing the periosteum over the tendon, or of fashioning a retaining ligament from a fascia lata transplant. The peroneal tendons may be retained by a free transplant from the tendo Achillis (Lexer).

IV. TUMORS OF TENDONS

Tumors of tendons are mostly found about the wrist and fingers. They manifest themselves chiefly by offering mechanical hindrance to the free gliding of the tendon within its sheath. When superficially situated, as on the dorsum of the hand, the tendon-tumor travels up and down in the axis of the tendon during muscular contraction; but when moved by the fingers of the examiner, the tumor is more readily displaced laterally than up and down.

Owing to the histologic characters of tendon-tissue (intrinsically, white fibrous and yellow elastic; extrinsically, ordinary fibrocellular connective tissue—endotenon), one may expect fibromata and sarcomata: in fact, these are the varieties which are found, and the fibromata are of the purest type.

Such a tumor was reported by Sendler in 1888. A swelling appeared on the volar surface of the forearm, just above the wrist (palmaris longus tendon): it caused darting pains in the three radial digits and relaxation of the thenar muscle (pressure upon median nerve), and the hand became easily fatigued. The usual diagnostic error of tense hygroma was made. At operation a spindle-shaped tumor was removed, which proved to be a pure fibroma. After operation there occurred temporary median-nerve dystrophy, with typical turtle-shell nails and superficial gangrenous patches at the finger-tips.

Sarcomata require no comment, except to state that, like other fibrous structures, tendon offers a lengthened resistance to their progress.

Small cartilaginous enlargements are often found in the course of tendons, especially those of the hand and foot; they do not grow to a large size, and seldom produce any inconvenience.

There is a condition termed *trigger-finger*, which is due to an enlargement in the course of the flexor tendon: when the finger has attained full flexion, the enlargement has traveled upward with the tendon until it slips out from beneath the proximal edge of the tendon-sheath, opposite the transverse fold of the palm. The finger is now locked in flexion and cannot be voluntarily extended: when forced with the other hand, it flies open with a snap, like opening a jack-knife. The treatment consists of division by subcutaneous fasciotomy of the proximal portion of the tendon-sheath: a narrow-bladed knife perforates the skin of the palm at the transverse crease and over the metacarpal bone, makes for the proximal mouth of the sheath, enters it, and, with the blade directed toward the palm, slits it up for ½ inch (Abbe's operation). The snap no longer occurs, because the thickened site of the tendon no longer encounters the sharp and rigid sheath-edge. The same result is obtained if the lesion is due to contraction of the groove in the transverse ligament in the palm (Tubby). The presence of rheumatic or gouty nodules must not be overlooked.

V. WOUNDS AND INFECTIONS

A *punctured wound* is one of the most deceptive of injuries. The inexperienced examiner is apt to gage the extent of damage to the deeper structures by the extent of division of the skin. A moment's reflection proves the fallacy of this premise: the skin is elastic and may be relied upon to diminish the orifice of a punctured wound by its contraction; the perforating instrument may slide in the depths, carrying the skin with it as a collar. Therefore, every punctured wound should be investigated for injury to deeper structures—not only tendons, but also nerves and blood-vessels. The best way to be sure of one's ground—in addition to functional examination—is to convert the punctured into an incised wound and explore: this is likewise the old, old surgical maxim for the prophylaxis of tetanus by local treatment of the wound. One should deal with gunshot (a variety of perforating) wound of the extremities by the same wholesome skepticism.

The most dangerous of all injuries to tendons, as far as the result to the patient is concerned, is the subcutaneous division of the tendons. This occurs with the peronei, the posterior tibial, and the palmar and dorsal tendons of the fingers. I recall a case which occurred in 1888. A young man was carrying a stove when his hand was bruised between the latter and the jamb of the door. There was no abrasion of the skin, but the profound and sublime flexor tendons of the index, middle, and ring fingers were all divided just below the annular ligament. The nerves, arteries, and the flexor tendons of the thumb and little fingers were not disturbed. The median nerve, when exposed, was not divided, but there was a suspension of axonal transmission for many weeks. The division occurred when the muscles were under great tension, while carrying the heavy weight.

I made an incision 3½ inches long, dividing the annular ligament, and sutured the tendons end to end with silk. The wound healed without suppuration; there was no fixation of the tendons to the sheath, and the functional result was perfect.

An *incised wound* is a small matter, for experience teaches that the divided ends rapidly unite if kept in contact, uniting by first intention like other tissues. The material for this union appears to be supplied rather by the sheath than by the tissue of the tendon, and the two ends are joined by a mass of callus (like a fractured bone) which is at first adherent to the neighboring parts. These adhesions are dissevered by motion, and the exuberant callus wears off by friction, so that the point of union cannot be detected even by a longitudinal section of the tendon. Later in the course of repair the tendon is restored by proliferation of the true tendon-cells.

The great difficulty in injuries of tendons lies in the retraction of the divided ends—a separation which is greatest when the tendon lies in a long synovial canal. The two ends become adherent in this position of separation, and the muscle suffers atrophy from disuse; even if the ends are united by the interposition of new tissue, the muscle loses in power.

Whenever there is a possibility that tendons have been injured in a wound, especially upon the anterior surface of the hand and forearm, the action of every muscle should be examined. All the movements of the hand should be made, the fingers spread apart (loss of the power to separate the fingers indicates that the ulnar nerve has been injured—later *main en griffe*), and the fingers flexed while separated, and due allowance made for the action of auxiliary muscles. The projection of the tendons under the skin must be looked for. Another reason for thorough examination of the action of the muscles in fresh injuries is the great danger of overlooking some tendon when more than one have been injured.

In the examination of such wounds full aseptic precautions must be employed. Anesthesia and Esmarch's method are very useful, the former assisting as much by relaxation of the muscles as by prevention of pain; the latter, by keeping a screen of blood from the operative field.

By moving the limb in a direction opposite to that in which the affected muscle moves it, the retracted ends of the tendon can often be made to appear in the wound. Should this fail to bring the proximal end into sight, the muscle must be strongly compressed and stroked downward from its origin toward the periphery by the hands of an assistant or by the rubber bandage wound around the limb from above downward. Some attempt to lay hold of the end of the tendon with forceps inserted into the sheath, but there is great danger of septic infection in this maneuver, as well as danger of tearing or contusing the tendon. It is far better to enlarge the wound at once, and to prevent subsequent adhesion between the skin and the tendon a pedicled flap of fat may be placed around the tendon, or Witzel's method employed. An incision is made in the skin beginning at the wound, to one side of the tendon and parallel with it, and a flap is dissected up until the tendon is exposed: the sheath of the tendon is then opened, if possible, on the side.

In the presence of *sepsis* tendons are practically helpless; their phagocyte-mobilizing power is minimal; they rely for protection upon their sheaths, for nutrition upon the blood-vessels which are conveyed to them chiefly through the mesotenon or vincula, and then through the septa of the endotenon: deprived of this protection and nutrition they succumb—not wholly directly to the bacterial invaders, but also indirectly to curtailment or cutting-off of their blood-supply from septic thrombosis or unrelieved intrathecal inflammatory tension. The question of tendon-sepsis, therefore, belongs to the surgery of the tendon-sheaths, with which it will be considered: suffice it to say here that when gangrenous a tendon—like a sequestrum—maintains the patency of a sinus until absorbed or removed—a condition seen every day in the pathology of felon. The tendon is never the site of a metastatic infection.

The lesion *tendinitis Achillea traumatica*, as described by Schanz in 1905, is an inflammation of the Achilles tendon itself, due to overwork. It gives rise to a limp, and is mitigated by high-heeled shoes; the tenderness and swelling are in the tendon itself, —not at its insertion,—thus differentiating it from Albert's retrocalcaneal bursitis. This type of bursitis, however, is a much commoner lesion, and is frequently caused by the wearing of low-heeled shoes. It, like the inflammatory disease of the tendon, is relieved by high-heeled shoes and the same type of plaster support (see vol. iv, June, 1915, 505–526). Treatment consists of relaxing the tendon by flexing the foot, maintaining the relaxation by passing a long adhesive strip along the planta pedis over the heel and up the leg to the knee, applying over all a figure-of-8 bandage. Cure results in about three weeks. This lesion was also described by Tatum in 1862.

As to *tuberculosis of tendon*, it was formerly thought that, by reason of their scanty blood-supply, tendons were immune to tuberculosis, and isolated examples of the lesion were reported as great rarities. Closer investigation, however, showed that it was not unusual for tendons to be attacked by tuberculosis, but always secondarily to long-standing tuberculous tenosynovitis.

Syphilis occasionally attacks tendons and produces circumscribed thickenings, which Bouisson found to be formed by deposit between the tendon-fibers, as in muscles. Lisfranc speaks of certain node-like swellings of syphilitic origin on the surfaces of tendons, which he calls "nodosités blanches des tendons."

VI. TRANSFERENCE

The principles of tendon-transference are amply alluded to in our comments upon the operative cases in this number. Based upon the practical application of a knowledge of tendon-anatomy and physiology to the technic of tendon-operations, Mayer advocates the physiologic method of tendon-transference (*Surg., Gynec. & Obstet.*, March, 1916, 298–306). The principle of this method is exposed by the accompanying diagram (Fig. 38). The implantation of the tendon-end beneath the periosteum and fibrous tissue gives the ideal type of security in the fixation of the tendons where the end is implanted. It does not suffice to suture the tendon into the surface of the periosteum or fibrous tissue—it should be implanted beneath it. This can be accomplished by splitting the periosteum and fibrous tissue and with a loop stitch the free end of the tendon can be imbedded beneath both. Adhesions are prevented by employing Biesalski's technic of utilizing the sheath of the paralyzed tendon to accommodate the transferred tendon: the former is, of course, withdrawn from the sheath to make way for the latter.

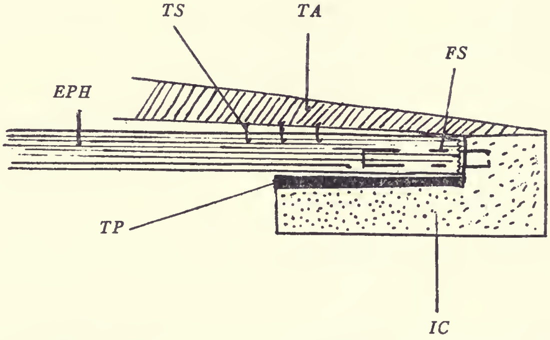

Fig. 38.—Diagram illustrating the principle of the physiologic tendon fixation. The fixation suture gives the mechanical stability; the adhesion of the tendon to the traumatized periosteum and to the superimposed tibialis tendon gives the physiologic security. *TS*, Tendon sutures; *TA*, paralyzed tibialis anticus; *FS*, fixation suture; *IC*, internal cuneiform; *TP*, traumatized periosteum; *EPH*, tendon of the extensor proprius hallucis (Mayer).

In the *suture of tendon* the needles of Hagedorn are best, because they separate the fibers without tearing them. The best material for sutures in aseptic cases is fine silk. Any suture which is at all constricting will prevent union by cutting off the blood-supply: hence, Nicoladoni's suggestion to make the sutures of the most delicate material and to relieve them of tension by passing a catgut suture through the tendon and the tissues overlying it, at a distance of one inch above the point of division, is excellent. The greater security afforded by these relaxing sutures enables the surgeon to make passive movements of the limb, and thus to place the sutured point so that it does not correspond with the wound; or, when more than one tendon has been injured, to arrange the points of suture of different tendons so that they do not lie on the same plane—a plan that is followed in our operations for Volkmann's contracture.

In the presence of sepsis primary suture is contraindicated: intermediate suture in the granulating wound when all signs of sepsis have disappeared is the correct procedure.

Secondary suture of tendons, the wound having completely cicatrized, may be begun with a rectangular or convex flap, the long side lying to one side of the tendon and parallel with it. The tendon must be very carefully dissected from the cicatrix with *blunt* instruments, so as to avoid subsequent ulceration. If there is cicatricial tissue filling the gap between the ends, it must be dissected out and left attached to the tendon: the ends are then freshened and united with sutures.

Wherever the tendons have been destroyed and there is not sufficient tendon-material left for elongation, homologous transplantation should be performed. Portions of tendon can be taken from any of the other tendons in the patient's body—the tendo Achillis being an excellent source. The long flexor tendons in the forearm can have some of their substance removed without impairing their function. A case is reported in this number in which a loss of substance of the tibialis anticus at the musculotendinous junction was repaired by a tube of fascia lata covered with fat. Glück has even experimentally employed strips of India rubber as grafts. Silk will often favor the generation of a sufficient quantity of connective-tissue fibers to carry on the function of the tendon until the latter has reëstablished itself. As alternative resorts there remain the implantation of the proximal stump into the tendon of a neighboring muscle which has a similar action; its attachment to a less important muscle, the tendon of the latter being cut away; or the splitting of an uninjured tendon and muscle so as to form two, and using one to replace the tendon which has been lost.

Tendon transference for the relief of deformities of the upper and lower extremity and for overcoming the effects of anterior poliomyelitic paralysis is one of the most fertile of the uncultivated fields of surgery. Braces and splints are crude mechanical means for assisting this unfortunate class of patients. In a very large percentage of the cases properly studied, and with a technic worked out in each individual case, great permanent relief can be afforded. Indeed, the results in many of these cases are most astounding. There is practically no operative risk, the period of confinement is short, and if a proper technic is resorted to the result is permanent relief.

Among the bizarre uses to which tendon has been put is that of an autogenous suture material in herniorrhaphy, as suggested by McArthur in 1901. The material is obtained from the aponeurotic tendon of the obliquus externus abdominis muscle, and the method offers the advantage of not introducing foreign material. Another use is exemplified by the experiments of Vulliett on suspension of the kidney with the tendon of the latissimus dorsi. Still another use is in the cinematoplastic method of amputation advocated by Vanghetti in 1898. The design of the operation is to construct one or more tendinous (or muscular) loops at the end of the patient's stump, so that the voluntary movements of these loops may be transmitted to an artificial hand. The employment of a tendon to reinforce a ruptured ligament has been previously referred to (February, 1916, 130), the case being one of rupture of the internal lateral ligament of the knee-joint, which was reinforced by superimposing the tendon of the gracilis upon it.

VII. THE TENDON-SHEATHS: INFLAMMATION

In the course of this talk we have endeavored to establish and maintain a distinction between affections of tendons and affections of tendon-sheaths: this distinction is based upon the newer anatomic, physiologic, and pathologic interpretations of these structures. Let us draw a comparison between the abdomen and the tendon in its sheath: the protective fibrous sheath may be likened to the abdominal wall; the synovial lining with its extensions (peritenon) to the peritoneum—both clothed by mesothelial epithelium (endothelium); the fatty areolar tissue of the paratenon to the subperitoneal fatty areolar tissue; the blood-vessel bearing mesotenon to the blood-vessel bearing mesentery; and the inclosed tendon to the inclosed bowel. If the reader will pause for a moment to interpret this comparison in anatomic and pathologic terms,—both gross and minute,—he will at once grasp the idea and save us much valuable space. The viability of the gut (tendon) is dependent upon the vitality of the mesentery (mesotenon); and there are diseases peculiar to the gut (tendon), and those peculiar to the peritoneum (esotenon), but withal a close interrelationship between the two.

Acute aseptic tenosynovitis is a friction-inflammation of the synovial tendon-sheath due to unaccustomed excessive gliding of the tendon. It is typically seen in the extensors of the thumb, where they cross the dorsum of the lower fourth of the radius obliquely from within outward. In addition to the oblong swelling which arises from effusion within the sheath, palpation reveals a very distinct leathery crepitation on motion—quite similar to "crunching" of freshly fallen snow underfoot. The lesion has been mistaken for fracture of the radius, for it may follow contusion. The old method of treatment of this fairly frequent condition varied from the blind application of ichthyol to splinting for a period of three weeks. By applying a fly-blister over the course of the swelling and immobilizing the wrist-joint and thumb with a splint, the crepitation may be made to disappear within twenty-four hours, with complete resolution within a few days—a saving of much time for a wage-earner.

Suppurative tenosynovitis may be compared with suppurative peritonitis not only in its pathogenesis, but also in the sequelæ of neglected cases: on the one hand, fibrous adhesions immobilize the tendon and, on the other hand, the gut. For practical purposes, however, a more forceful comparison may be made with acute suppurative osteomyelitis, owing to the situation of pus-products under great tension in both instances. We have repeatedly inculcated the importance of *early* intervention in cases of acute suppurative osteomyelitis, lest extensive death of the bone should result from delay: only in the latest number did we illustrate by a series of sketches the rapidly devastating march of pus in the malady (CLINICS, February, 1916, Figs. 25–31, pp. 173–176). No less true is this of suppurative tenosynovitis: pyogenic bacteria invade the tendon-sheath; inaugurate an inflammation which spreads like wildfire along the synovial lining; excite an outpouring of pus-products the great tension of which, as they accumulate in the fibrous sheath, seriously hazards—if not actually destroys—the blood-supply through the mesotenon or vincula, with inevitable death of the tendon. *It is just as urgent to give vent to pus under tension in a tendon-sheath as to give vent to pus under tension in the medullary canal of a bone.*

The pathogenesis and treatment of *felon* have been previously considered (February, 1915, 151—diagram of a felon). At times the question of the depth of a finger-infection offers a perplexing problem. Apprehension of the fact that in suppurative tenosynovitis the tense distention of the tendon-sheath with the products of pyogenic infection must needs interfere with flexion, is indicative, because based on that sound cardinal sign of acute inflammation, *functio læsa*. However, even the most astute of surgeons fails at times to gage accurately the depth and extent of a finger- or hand-infection—even after incision. The reason is plain. Operating without an anesthetic and without Esmarch's anemia, as is the wide-spread custom, *the surgeon does not see what he is doing*. The blade of the knife is not sensed with vision, and *to thrust a blind knife blindly into the human hand is nothing, if not criminal*. Therefore, *every acute, deep infection of the hand should be treated by an exploratory dissection under anesthesia and anemia*, since with anesthesia the surgeon is enabled calmly to explore the infected area, and to determine its depth and ramifications, whereas without anesthesia it is guesswork; and to leave a pocket of pus in the hand unreached by drainage—even for a few hours—may cost the patient his limb, a prolonged convalescence, or his life. In view of the foregoing, *to operate without an anesthetic is sheer brutality, surgical tyronism, unjustifiable, and indefensible.*

It is one thing to rid a hand of infection and preserve the hand; it is quite another thing, however, to rid a hand of infection *and* *preserve the function of the hand:* the immense importance of the latter to wage-earners is beyond the range of financial calculation. The number of hands permanently crippled by ill-directed "slashing" operative incisions is legion: they would fill the skeleton-closet of the medical family. Those desirous of obtaining restoration to complete function in 95 per cent. of the abscesses of the fascial spaces and of reducing the morbidity in tendon-sheath infections by 50 per cent. are advised to study the classic work of

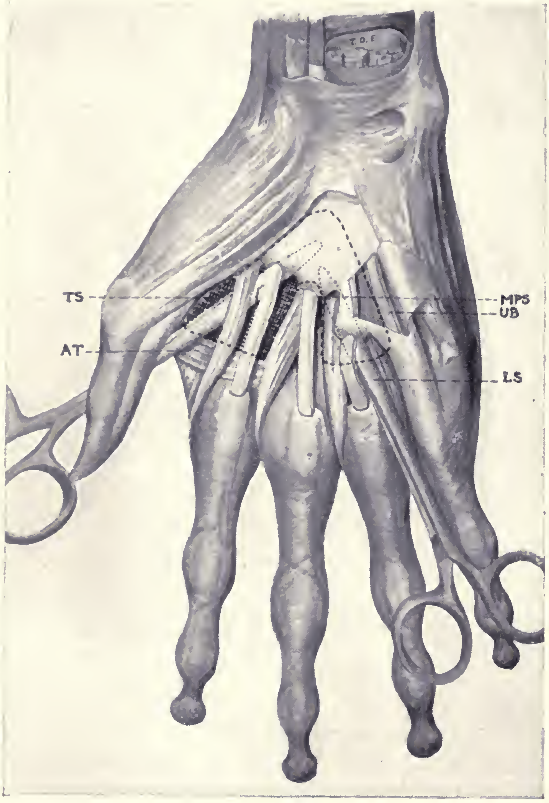

Fig. 39.—Showing the drainage under tendons. *AT*, adductor transversus; *LS*, lumbrical space; *MPS*, middle palmar space; *TS*, thenar space; *UB*, ulnar bursa (Kanavel).

Kanavel on "Infections of the Hand." The art of getting into a pus-pocket and getting out again with the least amount of damage to the hand is well worth cultivating: we reproduce a cut from Kanavel's book suggesting how this may be done (Fig. 39).

The incisions for drainage of infections of the hand have been improperly made for centuries, and it is difficult to repress these habitual and inbred errors. No long incision should ever be made in the palmar surface of the hand or fingers, parallel with their long axes. If the tendon-sheath is infected in the fingers, a short longitudinal incision should be made between the two joints; one continuous incision should never be made, even when the tendon is entirely gangrenous. Longitudinal incisions should never be made through the joint folds on the palmar surface. These long incisions and skin-fold incisions develop keloids and contractions which it is next to impossible to repair. Many short transverse incisions may be made, all the way from the tip of the finger to the annular ligament, for drainage or exposure of the tendon-sheath in a most effectual manner. Care should be exercised in these transverse incisions not to extend them far enough laterally to divide the sensitive nerve-trunks. The longitudinal incisions that are made on the palmar surface often contribute more to the incapacity of the hand subsequently than does the infection itself.

Tuberculous tenosynovitis (compound ganglion) is discussed in the comments upon an illustrative case in this number. The malady must be distinguished from *lipoma arborescens*. The tendon-sheaths of the peroneus brevis and longus are not infrequently involved and then are often treated as flat-foot. In the last year I have had two cases of this class.

VIII. TUMORS OF TENDON-SHEATHS

A *simple ganglion* is, according to Bowlby, a small, tense, round swelling, which is firm, grows progressively though slowly, is painless when uninflamed, and contains a fluid of the appearance and consistence of glycerin-jelly. Though occasionally seen upon the dorsum of the foot, a simple ganglion is commonest upon the dorsum of the wrist. The previously accepted theory that a simple ganglion was a hernial protrusion of a tendon-sheath has been controverted by the researches of Ledderhose and Thorn, who have proved that these tumors are cystomata arising from colloid degeneration of an area of connective tissue adjacent to a tendon (or the capsule of a joint), this area of tissue having been rendered extremely cellular by traumatism: a number of minute cysts thus form and they coalesce into one cyst, which may form a secondary communication with the interior of a tendon-sheath or joint. Simple ganglia occasionally diminish in size or even disappear spontaneously (Da Costa). Treatment consists of ablation of the cyst under strictly aseptic precautions. Subcutaneous rupture of the cyst with scattering of its contents does not guarantee against recurrence: a blow from a light Bond splint is just as effective as one from a heavy book.

Lipomata are to be expected in tendon-sheaths owing to the presence of fatty areolar tissue in the paratenon. The palmar synovial bursa is not an infrequent site, and harbors 1.33 per cent. of lipomata throughout the body. A lipoma in this situation must be differentiated from tuberculous tenosynovitis (compound ganglion): both lie under the palmar fascia; the former is not so movable as the latter, nor does it invade the region of the wrist or lower forearm, but it may project through the interosseous spaces into the dorsum of the hand; the latter has the opposite characters.

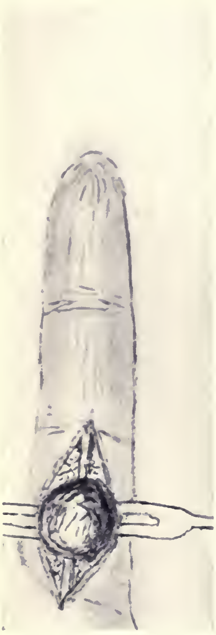

Fig. 40.—Giant-cell tumor of tendon-sheath at the base of the flexor surface of the little finger (Beekman).

This is the *lipoma arborescens* of Johann Müller: it is due to an advancing hyperplasia of the normal fatty tissue. It is the same tumor as that which was described by Malgaigne in 1844 in connection with the deep infrapatellar bursa over the head of the tibia (see February, 1916, Fig. 23, p. 163). Haeckel described such a tumor in a patient who first noticed pain in the left index-finger three years previously. A well-defined swelling appeared upon the dorsum of the index and varied in size—at times increasing and again diminishing. Crepitation like that due to rice-bodies was felt. On incision a honey-like fluid escaped, and the tendon was covered with a light, yellow growth of soft consistence, with reddish-yellow spots. The growth was characterized by small prominences, partly club-shaped, partly grape-like, and with a long pedicle.

Sarcoma is a common tumor of tendon-sheaths and presents both the mixed-cell and the giant-cell (myeloid) type: the latter are benign, well encapsulated, and usually shell out with ease. There is often a history of localized trauma having preceded the appearance of the tumor.

Beekman (*Annals of Surgery*, December, 1915, 738) reports three cases of giant-cell tumors of the tendon-sheaths (see Fig. 40), and states that they appear to be fairly common, for among 71 sarcomata of tendon-sheaths reported by Rosenthal, 45 were of the giant-cell variety, and Tourneux collected 54 of the latter type in the examination of 93 sarcomata.

Destroyed tendon-sheaths may be replaced by free or pedicled fascia-fat flaps (June, 1915, 502—illustrations).

RETENTION CYST OF LIP—ABLATION

Summary: Clinical history of patient; comments—nature of cyst; operation—ablation; postoperative comments—observations upon the histology of the lip and the surgical pathology and treatment of labial cysts.

CLINICAL HISTORY OF PATIENT

A FEMALE, thirty-two years of age, was admitted to Mercy Hospital November 12, 1915. The family history reveals that the patient's mother died of carcinoma of sigmoid when seventy-four years of age; and that a sister died of tuberculosis when thirty-one years of age.

Six weeks previous to admission the patient noticed for the first time a small irregularity on the left side of the inner surface of the lower lip, and ten days later blood was evacuated through an incision.

The lesion is slightly painful, and the tissues around it seem harder than the normal, but it has been cauterized several times with pure phenol.

COMMENTS AND OPERATION

DR. MURPHY (November 2, 1915): What is the matter with the patient?

INTERN: She is suffering from a retention cyst on the inner surface of the lower lip.

DR. MURPHY: As it appears to me, that is an inclusion-cyst. What do I mean by an "*inclusion-cyst*"? When a person accidentally bites his lip, he is liable to detach with his teeth a portion of the labial mucosa and "sequestrate" or bury it in the deeper tissues of the lip. Such a sequestration of epithelium must be regarded as a precancerous lesion, and treated as such by removal with the knife, going wide of the lesion into healthy tissue. [Ablates cyst.] . . . . The specimen contains serous fluid: if it originated from a defect in the closure of a duct, it will show a cubical epithelial-cell lining, otherwise a squamous cell.

POSTOPERATIVE COMMENTS

It remains to determine how much of the tumor is cystic and how much solid. In his "*Lectures on Surgical Pathology*" Sir James Paget describes the following specimen of labial cyst:

In the Museum at St. George's Hospital is a tumor removed from a man's upper lip, in which it had been growing, without pain, for eight and one-half years. One-half of it is a cyst that was filled with a thin, flaky fluid, and was thought to be a dilated labial gland-duct; the other half is a solid tumor.

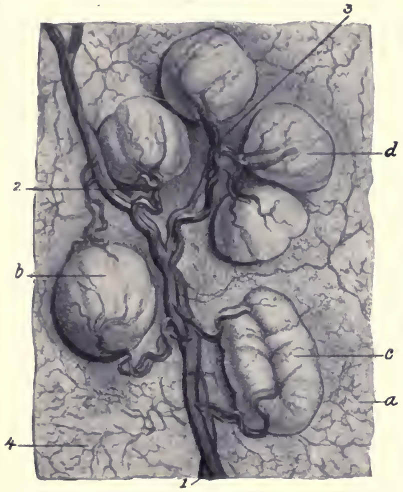

Fig. 41.—Labial salivary glands. × 8. Labial mucosa seen from its deep or adherent surface: 1, Vascular branch on its way to glands and mucosa; 2, 3, glandular arteries; 4, deep capillary network of the capillary mucosa (Bonamy, Broca, and Beau).

As the retention cyst enlarges, its wall undergoes compensatory hypertrophy to prevent eventual rupture from excessive thinning: it is therefore not always easy to differentiate between simple proliferating cysts and cystic neoplasms (cystadenomata), as Paget's case shows.

Sebastian (*Recherches anatomiques, physiologiques, pathologiques, et semeiologiques sur les Glands Labiales*, Gröningen und Bremen, 1842) counted as many as 57 of these glands in the lower lip alone. Their diameter varies from ½ to 1½ mm., or more; and as a rule their size increases in proportion to the smallness of their numbers. They may be plainly felt as little miliary bodies beneath the mucosa, and can be rolled about beneath the finger (Fig. 41). They are acinous in type, and miniatures of the salivary glands. They open on the surface of the mucous membrane by means of small excretory ducts whose mouths may be seen with the naked eye, or with the aid of a pocket lens, by everting the lower lip: if now the everted lip be dried with a handkerchief and its surface watched for a moment, minute drops of secretion appear one by one on the mucous surface of the lip, like stars in the sky after sunset. Their function, therefore, is to aid the posteriorly-situated parotid salivary glands in keeping the buccal cavity moist where it is most subjected to the effects of drying, especially during speech.

Below the plane of the stratified squamous epithelium lining the mouth each excretory duct is lined by a single layer of cylindric epithelium. After uniting the acini into a lobule and the lobules into lobes, the submucous connective tissue continues as a sheath for the excretory duct in its passage through the mucous membrane.

Referring to the contents of mucous cysts as a class and the metamorphosis of the epithelium which lines them, Virchow ("*Die krankhaften Geschwülste*," 1863, Band I, 236) says:

"The contents are usually twofold—mucous and epithelial cells. If the epithelial cells are very numerous, the fluid-content naturally assumes a cloudy appearance. The epithelium does not always correspond with the epithelium which was previously present. The more the sack broadens out, the more the character of the epithelium is altered, as a rule; and while in the beginning one finds in the sack the same epithelium as was originally present,—pavement epithelium when there was pavement epithelium, cylindric epithelium when there was cylindric epithelium, ciliated epithelium when there was ciliated epithelium, —it may later happen that one finds pavement epithelium alone, where previously cylindric or ciliated epithelium was present."

This follows the usual course of pressure change produced in cylindric-cell lined cysts.

Retention cysts whose walls are composed of more than one kind of epithelium, or containing secretions from glands discharging into them, are often called *composite cysts* (sequestration and implantation cysts).

Through traumatic or surgical displacement of portions of epithelium into mesoblastic tissues cysts may be formed from the resulting proliferation of the included epithelium (*inclusion cysts*). Kaufmann's experiments in enkatarrhaphy are well known. He found that the inclusion of portions of a cock's-comb was followed by the formation of cysts lined throughout with epithelium and containing material resembling that found in atheromatous cysts: the growth of these cysts continued until a certain limit was reached, when they remained stationary. Similar cysts have been observed in the human body arising from implantations of portions of epithelium after trauma to the skin—especially of the scalp—and mucous membrane, as from biting the lip. They are found more frequently in the scars of burns than after wounds. Warthin has observed a case of multiple cyst formation after the removal of a portion of the jaw in a case of giant-cell sarcoma. The cysts, the largest of which was of the size of a hen's egg, were lined with stratified squamous epithelium, most probably derived from the mucous membrane of the mouth. Such displaced portions of epithelium do not possess the intrinsic capacity for unlimited growth, as is seen in the cell-nests of epiblastic tumors.

Both retention and traumatic epithelial cysts must be thoroughly removed, otherwise they may recur.* It does not suffice to rupture or merely puncture such a cyst as our patient presented; in fact, had we not removed the sac *in toto* the patient would have returned within two, three, or four weeks after the operation with a recurrence of the cyst; for it is the function of the cells that line a cyst to secrete, and their function can be abolished only by destroying the cells themselves, either by removal *in toto* or by resection of part of the cyst-wall, followed by cauterization of the remainder. The attempt to cure a cyst by resecting part of its wall and leaving the remainder behind with healthy, vigorous, secreting cells is like trying to rid a patient of tapeworm by vermifuging all the segments and leaving the head behind.

Because of the epithelial proliferation referred to above, cysts should be classified as precancerous lesions; and it is well to scotch the snake before being bitten.

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* Of practical aid when removing these cysts is the suggestion of Sir Charles Bell, to stretch the lip over the finger of an assistant.

TORTICOLLIS—DIVISION OF STERNO-MASTOID MUSCLE

Summary: Clinical history of patient; comments—causes of wry-neck; the pathology of wry-neck; principle of operative treatment; operation—subcutaneous "tenotomy"; dressing.

CLINICAL HISTORY OF PATIENT

A FEMALE, seven years of age, was admitted to Mercy Hospital September 6, 1915. The family and past histories are negative.

Two years previous to admission the patient suffered a very severe attack of tonsillitis, which lasted for three weeks: the malady responded to medical treatment without quinsy supervening.

When the child got about playing, the mother noticed that its neck was so contracted that the head was inclined toward the left shoulder and the face toward the sound shoulder. During the past year the degree of contraction has increased, and the patient has become very nervous.

At no time has there been pain, nor have there been signs of dental caries. The mother states that a slight degree of contraction *may* have been present when the child was born, but that following the attack of tonsillitis the contraction became both definite and well marked.

COMMENTS

DR. MURPHY (September 9, 1915): The patient is suffering from torticollis, or wry-neck—a lesion the types of which vary with the etiologic factor. The commonest variety is that due to muscular contraction, which, in turn, is tonic if neurogenous and cicatricial if the result of infection: in other cases wry-neck follows lesions of the spinal column and paralytic release from the balancing action of the corresponding muscles of the opposite side. Thus, wry-neck is merely a deviation of the contour of the head and neck, which is expressive of many types of pathology, and the successful treatment of the lesion depends upon accurate recognition of the underlying pathology.

The cervical region of the spinal column may give rise to torticollis when the seat of fracture, metastatic infective osteomyelitis, or tuberculous osteomyelitis: of these, the last is the commonest. Thirty-five years ago Henoch, in his spendid work on "Diseases of Children," described a variety of wry-neck which was due to cicatricial contraction of the cervical fascia, a legacy of subfaucial or post-pharyngeal abscess (*i. e.*, behind the mucosa of the pharynx) following infective osteomyelitis; he also described post-pharyngeal abscesses not associated with osteomyelitis. Metastatic infective osteomyelitis may result in a retropharyngeal abscess (*i. e.*, one behind the prevertebral layer of deep cervical fascia) or a lateral abscess; and so may tuberculous osteomyelitis, resulting in either a "cold" retropharyngeal abscess,—whose counterpart is seen in psoas abscess when the lumbar region is involved,—or in one to which pyogenic invaders have gained access. In these *spinal column* lesions the *power* of flexion and extension is preserved, but because of the underlying skeletal disturbances the neck is held rigid, and rotation even is very much limited.

Of the neurogenous varieties of wry-neck (these do not cause *true* wry-neck), the organic is manifested by tonic, spastic contraction and the functional by a clonic tic, which is seen in certain individuals who jerk their head to one side from muscular spasm, and which is akin to writer's cramp, facial tic, etc.

Fibrous myositis of the sternomastoid with contracture may be congenital (organized hematoma following rupture of muscle during traction of forceps-delivery) or acquired (thecal invasion secondary to suppurative mastoiditis, pharyngitis, quinsy, etc.). The whole muscle may be transformed into a firm, cicatricial band which binds the head down upon one side, as in this case, eventuating in deformity of the spine during the process of growth.

The cause of the wry-neck in this patient falls in this last category, and the muscle and its sheath are transformed into a tense, rope-like strand, which increased deposits of fibrous tissue are continually making harder and stronger. The principle underlying the treatment of annular scars—that of interruption of the scar-circle, so that relaxation may take place—applies to this class of cases as well, and after release of one end of the fibrous band absorption will begin.

OPERATION

[Manipulates head until affected muscle becomes tense.] Now you can see the tense band standing out prominently beneath the skin. I shall make a very small incision parallel with the long axis of the muscle, so as to avoid a contracture-scar in this little girl's neck. [Incision.] . . . I am making a spreading, subcutaneous dissection until the entire width of the fibrous cord is exposed in the field. . . . [Exposes contractured muscle.] Now you can see this clean-cut, white fibrous cicatricial mass involving the entire lower portion of the muscle: how little it resembles muscle-tissue! [Ligates tributaries of anterior jugular vein and with tenotome divides cicatricial band.] . . . . The yielding of this fibrous band as we cut it reminds one of the yielding of the tendo Achillis during tenotomy. . . . The relaxation following relief of the tension has resulted in total disappearance of the rope-like strand. [Incision closed with horsehair sutures.]

Dressing.—After rotating the head to the opposite side so as to overcorrect the deformity, we apply a plaster-of-Paris dressing which includes the head and *both* shoulders: this dressing will not be disturbed for six weeks. It would not suffice to apply a temporary apparatus which could be removed by the mother every time the patient cries.

Postscript.—The case progressed without untoward symptoms. The gypsum case was well tolerated.

CERVICAL RIB—EXCISION. COLLECTIVE REVIEW ON SURGERY OF CERVICAL RIB

Summary: Clinical history of patient; comments—estimate of extent of compression; operation—approach by lateral route; rib exposed and removed; postoperative comments—the applied pathologic anatomy of irritation-neuromata; persistence of traumatic neuritis after excision of rib; the morphology of supernumerary rib; explanation of tardy manifestation of signs in cervical rib. Collective review.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-four years of age, was admitted to Mercy Hospital November 2, 1915.

Nine months ago, on February 13, 1915, the patient slipped on the ice and fell. Two days after the fall he suffered from fever (100° F.), pain in the cervical region of the spine, and universal muscular tenderness, and took to bed for two days under the impression that he had caught la grippe.

Ten days after the onset of the pain in the cervical region of the spine it radiated down the left upper extremity until it reached the fingers, and has been constantly present since that time. The pain is worse nights. There is, however, no atrophy of the muscles of the hand, nor is there any alteration in the color of the skin. Pain is present in the right upper extremity.

Examination by Dr. Murphy (September 7, 1915).—Palpation of the neck reveals an elongation at the tip of the transverse process of the left seventh cervical vertebra—at the site which appears to be just under the point of greatest pain-irritation: the space between this process and the clavicle is diminished, but not occluded. In making the comparative examination between the right and left sides I find that on the right side I am able to insert my whole thumb into the supraclavicular space, while on the left but two-thirds of the digit can be inserted.

There is a seventh cervical rib on the left side which puts tension upon the eighth cervical nerve on its way to the ulnar.

We are not, however, dealing with the typical eighth cervical rib pressure syndrome, nor would the condition be interpreted as such except after a painstaking physical examination. Motion in the cervical vertebræ is normal. The lower portion of the left side of the neck is thickened. The von Wassermann reaction proved to be negative. The symptoms of cervical rib in the order of their frequency are pain, at first recurrent and then constant, mostly located in the index, ring, and little fingers; secondly, recurrent pallor of hand and forearm; thirdly, muscular atrophy; fourthly, gangrene of the dry type. The pain is neuralgic and ischemic. *Pain relief* by change of posture is an important symptom.

COMMENTS

Dr. Murphy (November 5, 1915): Of the regional structures which are liable to be encroached upon by a cervical rib (see vol. iv, December, 1915, 1069), the brachial plexus alone is involved here, as is shown by the presence of the pain in the shoulder (*circumflex nerve*) and the pains radiating down the arm and forearm into the hand (*ulnar*), and the absence of signs of arterial or venous block. So, too, excepting the nerve to the rhomboids from the fifth cervical, paralysis is absent, so that the nerve-involvement is not total. Had the rib been longer and extended more anteriorly, it would have encountered the subclavian artery and compressed it against the scalenus anticus muscle, causing disturbances of the radial pulse, ischemia, and even *dry* gangrene. Owing to its position *anterior* to the scalenus anticus the subclavian vein is sheltered from the rib, so that the latter never causes moist gangrene (Figs. 42 and 43).

OPERATION

[Incision along anterior border of scalenus medius muscle; scalenus anticus muscle freed high up on a level with upper margin of cervical rib.] . . . By blunt dissection we have reached a position behind the brachial plexus, encountering and ligating the transverse cervical artery and vein. Now you can see in the field the anterior portion of the cervical rib: instead of being a round, blunt process it is aciculated and exhibits a sharp, dentate edge which nips the brachial plexus and accounts for the pain

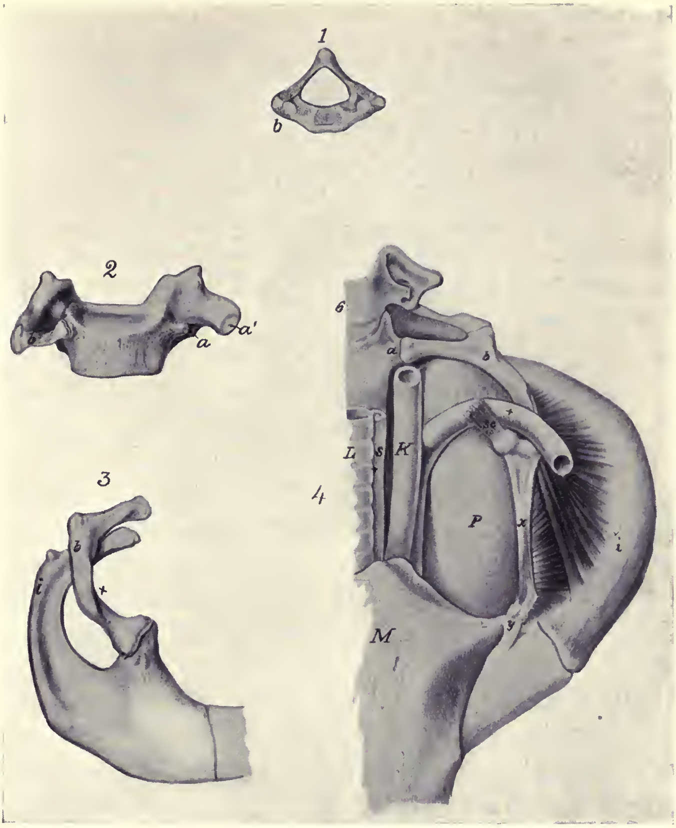

FIG. 42.—LUSCHKA'S ILLUSTRATIONS OF CERVICAL RIBS.—Fig. 1.—*Development:* Seventh cervical vertebra of a new-born in transverse section, showing independent center of ossification (*b*) in anterior root of transverse process: such a center corresponds to the costal element, and may persist in the form of a cervical rib. A similar center is occasionally found in the sixth cervical vertebra.

Fig. 2.—*Articulations:* Seventh cervical vertebra of an adult with a short cervical rib on right (*b*). On left side the rib has been removed to expose articular process (*a*) on side of centrum, and articular facet (*a'*) at tip of transverse process.

Fig. 3.—Cervical rib (*b*) of an adult articulating with first thoracic rib (*i*), which has thrown up an eminence to meet it. At *x* is a deep groove for subclavian artery.

Fig. 4.—*Orientation:* Left half of superior thoracic aperture of a forty-year-old man. The seventh cervical vertebra has on its side an eminence (*a*) covered with a joint-surface, with which a rib articulates. This cervical rib (*b*) drops from its anterior extremity a stout, cord-like strand (*x*), which is connected with a stub of a cartilage (*y*) supporting two small ossicles. Toward anterior end of rib a deep furrow lodges subclavian artery (+), and just beyond this the rib ends in a small knob to which is attached the scalenus anticus (*sc*) muscle.

Between cervical rib and first thoracic rib (*i*) there is found an intercostal space containing an external and an internal intercostal muscle.

The remainder of the picture shows the sixth cervical vertebra (*6*); the trachea (*L*); the gullet (*s*); the left common carotid artery (*K*); the lung (*P*); and the manubrium sterni (*M*). (Denksch. d. K. K. Acad., Wien, 1859, xvi, S. 8.)

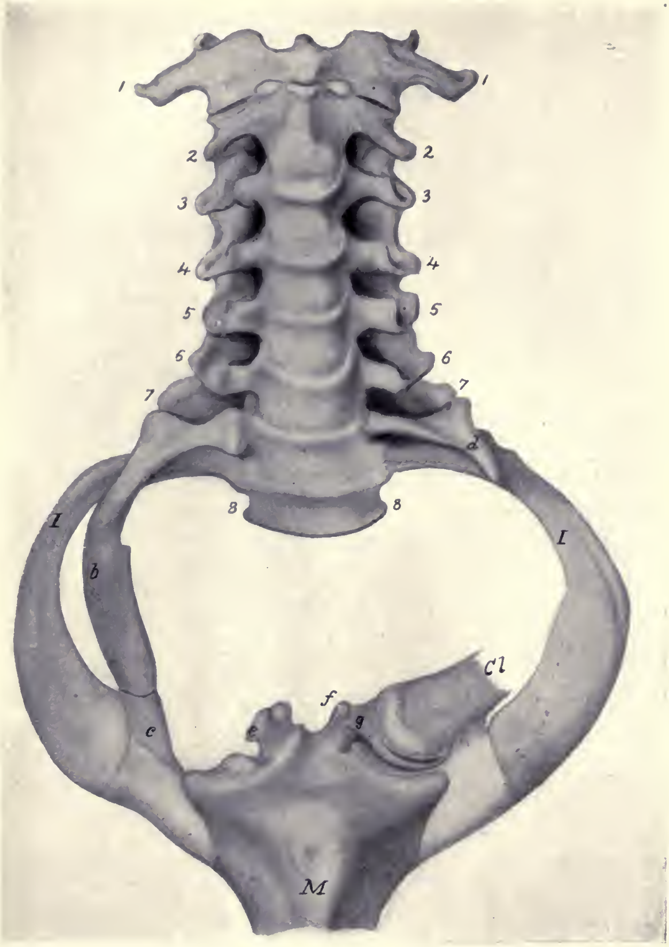

FIG. 43.—LUSCHKA'S ILLUSTRATIONS OF CERVICAL RIBS. Part of skeleton of forty-five-year-old male showing cervical vertebræ (*1* to *7*) with pair of seventh cervical ribs (*b*, *d*); first thoracic vertebra (*8*) with its ribs (*I*, *I*); left clavicle, sternal end (*Cl*); manubrium sterni (*M*); suprasternal bones (*e*, *f*).

The right cervical rib—the longer of the two—shows at its middle a deep subclavian groove, bounded mesially by a sharp spine to which scalenus anticus is attached, and by its anterior extremity articulates with costal cartilage of first thoracic rib at *c*. *g* is a ligament which binds meniscus of sternoclavicular joint with left suprasternal bone (*f*). (Denksch. d. K. K. Acad., Wien, 1859, xvi, S. 8.)

radiating down along the arm to the forearm and hand. The plexus has been displaced. [With periosteotome clears tissues away from cervical rib throughout its length, from tip to base, allowing periosteum to remain on rib; rib divided at its neck with short, bone-cutting forceps, and then avulsed with sequestrum forceps.] . . .

With the rib out of the way, it is clearly to be seen where the brachial plexus was compressed by the rib: the nerve to the rhomboids was involved, showing that the fifth cervical nerve, from which this branch takes origin, felt the stress of the compressing rib. [Spreads brachial plexus out in space gained by removal of rib and closes wound without drainage.]

POSTOPERATIVE COMMENTS

The knife-blade-like edge of the cervical rib had irritated the brachial plexus until a neuroma formed upon one of its constituents—the eighth cervical, from which the ulnar nerve is derived. The commonest site for these irritation-neuromata is the ulnar nerve in its retro-epicondylar groove at the elbow—a condition to which attention was called by Cotton, of Boston: two examples of this were published in a recent number of the CLINICS (vol. iv, December, 1915, 1095–1108); see also Hunt's article (*Jour. Amer. Med. Assoc.*, January 1, 1916, 11) reporting three cases following ancient fracture of elbow-joint, two of which were associated with the cubitus valgus deformity of Mouchet, which we illustrated and described in the above number, p. 1107.

Contrary to expectations, the traumatic neuritis initiated by the pressure of a cervical rib does not clear up immediately after operation, but often persists in an annoying manner, as was shown by a patient from whom a cervical rib was removed only six months after it had begun to manifest itself by irritative nerve-signs.

The occasional finding of a supernumerary rib in man is an atavistic reversion to the type of the limbless vertebrates, such as the snake, in which every vertebra has ribs attached to it. Why a cervical rib—which, being congenital, is of course present at birth—does not manifest itself by signs until many years later (the average age being twenty-two and one-half years and the exceptional age forty-three or forty-four) is problematic, but some attribute the initial appearance of signs to the changes in the conformation of the chest which occur in adult life. These changes are from a loss of tone of the muscles, leading to a relative sinking of the shoulders on to the thorax and thus increasing the angulation of the structures passing over the rib. So, too, the shoulders drop back as growth proceeds, especially in women, in whom cervical rib occurs in the proportion of 9 : 1.

Postscript (*January 7, 1916*).—The patient made an uneventful recovery, and at the present time the preoperative thickening which was present in the lower portion of the left side of the neck has to a great extent subsided.

(A case of bilateral cervical rib was published in vol. iv, December, 1915, 1067–1071.)

COLLECTIVE REVIEW ON THE SURGERY OF CERVICAL RIB

SYNOPSIS.—(*Darling*)

A. Costal Variations.
    Prefixed plexus with seventh cervical rib.
    Postfixed plexus with aborted first rib.
    Intermediate types.
B. Frequency.
C. Types.
    Free costal process.
    Small free rib.
    Chondrotransverse arch.
    Sternotransverse arch.
D. Anatomy.
    i. The rib.
        Vertebral extremity.
        Tubercle.
        Caudal extremity.
    ii. Relations of a cervical rib.
E. Symptoms.
    i. Those due to pressure on trunks of the brachial plexus.
        Motor fibers.
            Weakness and wasting.
            Reaction of degeneration.
            Spasm of muscles.
        Sensory fibers.
            Subjective.
                Pain.
                Paresthesia.
            Objective.
                Impairment of epicritic or protopathic sensation.
        Sympathetic fibers.
            Absence of pulse.
            Change of pulse rhythm.
            Local syncope, asphyxia, and gangrene.
            Impairment of thermal sensibility.
            Edema.
        Trophic fibers.
            Ulceration.

- ii. Those due to pressure on the subclavian artery.
    - Temporary obliteration.
    - Temporary delay of the pulse.
- iii. Tumor in supraclavicular triangle.
- iv. Associated changes.
    - Scoliosis.
    - Syringomyelia.

F. Clinical types.
- Neuralgic pain.
- Weakness and wasting.
- Pseudoacroparesthesia.
- Tumor in the neck.

G. Morbid physiology.
- Causation of symptoms.
    - Mechanical pressure theory.
    - Involvement of sympathetic theory.

H. Diagnosis.
- Differential diagnosis.

I. Treatment.
- Palliative.
- Operative.
    - Anterior operation.
    - Lateral operation.
    - Posterior operation.
- Results of operative treatment.

The scattered literature of cervical rib—a bibliography comprising 112 references—has been gathered together by Darling and published in the form of a collective review (*The Medical Journal of Australia*, October 23, 1915, 389; October 30, 1915, 414), and for the benefit of our readers we have culled the most interesting and important points from this comprehensive article.

Embryology.—In the developing embryo the nerves bud out from the neuroblast and extend to a limb-bud, which is co-terminous with the body-segments from which it arises. But as growth proceeds the limb-bud fails to keep pace with the antero-posterior growth of the body-segments from which it arose, and, consequently, the nerves are dragged together and form plexuses.

As the nerves in the cervical region are dragged down they prevent the mesoblastic intersegmental ribs from growing out: in other words, they cut the ribs off short. Thus an antagonism between the development of the brachial and cervical plexuses and the development of cervical rib is established. This antagonism is manifested by the presence of partially formed costal elements of a normal cervical vertebra.

Frequency.—Cervical rib occurs in about 0.03 per cent. of normal human beings, but only in about from 5 to 10 per cent. of these cases does it give rise to symptoms (Borchardt); the symptoms in about 70 per cent. are of a nervous character. Cervical ribs are bilateral in 75 per cent. of cases, but in only 30 per cent. of these instances are the symptoms bilateral. Cases have been recorded in which two cervical ribs attached to the sixth and seventh cervical vertebræ were present on one side (Beck, Ehrich, Struthers).

Types.—Gruber classifies cervical rib under the following heads:

1. *Smallest Type.*—In this type the rib does not project beyond the transverse process proper, and resembles the articular end of the thoracic rib with head, neck, and tubercle articulating with the body and anterior aspect of the transverse process of the seventh cervical vertebra.

2. A small rib reaches a varying distance beyond the transverse process and terminates in a free extremity, or by articulating with the osseous part of the first thoracic rib.

3. A rib reaches the first costal cartilage, with which it joins, either by means of a ligament or by direct contact.

4. The rib is in all respects like a first thoracic rib, articulating with the manubrium sterni.

Anatomy.—The rib is due to an excessive development of an ossific center, normally represented in the fetus by a separate center of ossification in the anterior root of the transverse process, which corresponds to the costal element.

The portion attached to the body of the vertebra is thin and narrow, and the rib increases in breadth as the distance from the spine increases. In front it may be continuous with a taut, fibrous or ligamentous band attached to the sternum or first rib. At times it is capped with cartilage and articulates with a buttress on the first thoracic rib, or it may end in a free extremity.

The vertebral extremity usually articulates with a facet on the body and transverse process of the seventh cervical vertebra. In this case the vertebrosternal foramen is completed by a separately developed cervical rib (the true cervical rib of Gilbert Scott), articulating with a normal seventh cervical transverse process.

In the rarer variety the cervical rib is fused by bony ankylosis to the seventh cervical vertebra (the false, or buttress type of rib of Gilbert Scott).

The costal extremity, as a rule, takes the form of an osseofibrous arch (Fig. 42, *4*, *x*, p. 229). The ligamentous structure connects the tip of the rib to the sternum, or more frequently to the first rib behind the sulcus subclaviæ.

Relations.—The muscular attachments are mostly well marked, and consist of an extra intercostal muscle,—usually the external,—of the scalenus medius and posticus, and occasionally of the scalenus anticus. At times the nerves and artery penetrate through the scalenus medius and divide it into separate fasciculi.

It is well known that the brachial plexus is subject to many variations. Slight degrees of prefixation and postfixation are recognized by a greater or less contribution from the nerve-trunks which mark its cephalic or caudal extremity. In the majority of cases in which a part of or the whole second thoracic nerve participates in the plexus it is the lower trunk which is implicated, and this is spoken of as "*the nerve of attack in cervical rib.*" In certain cases the seventh cervical nerve is picked out, either alone or in conjunction with the lower trunk. The sympathetic fibers are involved more than the spinal, although the reverse is more frequent. Ample evidence has been brought forward by Manouélian and Cehanovic to prove that damage to the sympathetic nerves supplying blood-vessels may be followed by pathologic changes in all the vessels supplied. The effect of the rib on the sympathetic appears to be at first a stimulation of the vasoconstrictor nerves, causing the pulse to become temporarily small and barely perceptible. Later this is followed by the development of patches of arteriosclerosis in the vessel-wall: these localized patches are characterized by degeneration of the elastic and muscular tissue, overgrowth of the connective tissue of the media, and marked proliferation of the media.

The *phrenic nerve* lies on the scalenus anticus and is more or less closely associated with a cervical rib. Hunt has reported a case of *spasm of the diaphragm* alleged to have been due to pressure of the cervical rib: the spasm was cured by the removal of the rib.

In its passage outward between the scalene muscles there is a well-marked sigmoid curve on the subclavian artery which allows of movement of the shoulder without damage to the vessel: this curve is more marked in children and in cases of cervical rib. Halbertsma enunciated the rule that when the supernumerary rib is more than 5.1 cm. in length, the subclavian artery usually passes over the rib, but when it is shorter than 5.1 cm. the artery usually runs in front of the rib. Ehrich reported a case in which the artery lay between a sixth and a seventh cervical rib. Murphy described the vessel as being spread out so as to cover about one inch of the surface of the rib and simulate aneurysm. This flattening, which may be noticed at the summit of the curve, is not due to the constriction of the muscles or an aneurysm, but is a practical application of the laws of hydrodynamics: engineers imitate it by flattening a tube for the purpose of carrying fluid over the summit of a curve (W. Todd).

In later stages there is a gradual progressive obliteration of the arteries of the limb, starting at the periphery and gradually spreading up the arm, as the sympathetic twig from the ansa subclaviæ escapes pressure.

The *pleura* extends higher in the neck in case of cervical rib than under normal conditions: it lies in close association with the periosteum of a cervical rib, and is often intimately connected with it and may, therefore, be injured during the operation for removal of the rib.

Symptoms.—The symptoms of cervical rib are exclusively symptoms and signs of pressure and of displacement of certain structures.

The first *motor fibers* to be impaired are those controlling the finer movements of the hand, *e. g.*, those necessary for holding a needle in sewing, writing, picking up pins, piano-playing, etc. Later the extensors of the wrist and fingers become weak. The muscular involvement may affect the thenar eminence at an early stage: in 79 per cent. of the cases the *ab*ductor and opponens pollicis are involved, while the *ad*ductors are not affected until later (median type). In 20 per cent. of the cases the hypothenar eminence may be involved: this is known as the ulnar type.

Sensory symptoms occur long before the motor. The subjective symptoms consist of pain and paresthesia: pain occurs in about 75 per cent. of the cases and presents several distinguishing features. It is shooting or darting in character and usually unilateral; it is more commonly referred to the ulnar border of the forearm than to the radial side of the arm or fingers; it is intensified by cold weather, overexertion, as in swimming, washing floors, wringing clothes, piano-playing, painting, sewing, etc.; it always radiates in a downward direction (*centrifugal*).

Paresthesia occurs in the hands or fingers in 20 per cent. of the cases: it takes the form of a tingling and numbness or a sensation of pins and needles. The paresthesia may reveal the existence of pressure on the brachial plexus months or even years before the paralysis develops. The objective signs consist of a dulling or loss of epicritic and protopathic sensation: this is present in about 70 per cent. of the cases. The eighth cervical and first thoracic type is accompanied by a defect of epicritic and protopathic sensibility on the inner side of the forearm and also of the little finger: this is present in 65 per cent. of the cases. In the sixth cervical area type an epicritic loss is present in the outer two fingers and thumb alone: this form of sensory disturbance is met with in 35 per cent. of the cases. It is explained by a postfixation of the seventh root; and this root—and not the true sixth cervical—is involved.

Trophic ulcers and sores similar to the trophic lesions seen in syringomyelia may occur.

Vascular symptoms begin in the fingers and spread up the arm as the arteries gradually become obliterated. A condition in which the symptoms are indistinguishable from those of Raynaud's disease is met with.

Implication of the *sympathetic fibers* is evidenced by pallor, cyanosis, and localized gangrene.

Tumor-formation in the supraclavicular triangle has been noted in 20 per cent. of the cases: a palpable or visible swelling may be formed by the rib in the fossa. The swelling is hard, more or less rounded, usually fixed, and may often be traced back to the cervical vertebræ: it is often tender to the touch and may also cause the artery—which is displaced upward—to be prominent, so that visible pulsation is present and is accompanied by a thrill and a bruit, which latter is not usually conducted down the arm. Aneurysm of the subclavian artery in association with a cervical rib is extremely rare; but it should never be assumed that there is an aneurysm: this should be proved by dissection.

Of *associated changes*, the most important is scoliosis, as was first pointed out by Garré: in 2 per cent. of persons affected with scoliosis a cervical rib is present; while 5 per cent. of those who have cervical ribs are scoliotics. Syringomyelia in association with cervical rib has been described by Oppenheimer, Borchardt, Marbury, Schönebeck, and others.

In the **differential diagnosis** the condition must be distinguished from old-standing acute anterior poliomyelitis: in this the onset is usually distinctive and the course typical; the maximum effect appears at the onset and diminishes in the course of time; sensory changes are usually absent.

The second affection is chronic anterior poliomyelitis (progressive muscular atrophy of the Aran-Duchenne type): this is usually more or less symmetric; a selective picking out of the muscles does not occur; the sensory changes are absent and the muscles rarely show a complete reaction of degeneration—a simple diminution of the response to faradic and galvanic currents is more usual.

The third affection is syringomyelia: in this the changes are as a rule limited to the eighth cervical and the first thoracic roots; in addition, ocular changes, well-marked sensory dissociation, and changes in the reflexes occur. The association of syringomyelia with cervical rib has been referred to above.

The fourth affection is peripheral neuritis: in this the muscular wasting and sensory loss do not follow a root-distribution.

The fifth affection is uniradicular palsy of the brachial plexus—a vascular lesion of the first thoracic root which was described by Farquhar Buzzard: this can be distinguished by a skiagram.

The sixth affection is that which was described by J. Ramsay Hunt (*Amer. Jour. Med. Sci.*, February, 1911) under the title:

"The Thenar and Hypothenar Types of Neural Atrophy of the Hand": these are due, respectively, to compression neuritis of the thenar branch of the median nerve and of the deep palmar branch of the ulnar nerve from occupational pressure of tools, etc.

The **treatment** is palliative or operative: in the latter it should be borne in mind that the cervical rib lies much higher in the neck than would be expected, and the first thoracic rib has in several instances been removed by mistake; that a cervical rib is often very difficult to find: it is usually short and only projects one or two inches beyond the tip of the transverse process; that it is advisable to attempt to approach the rib behind the plexus instead of retracting the plexus forward: the latter method often leads to a more or less complete partial paralysis of the whole arm; that special care should be exercised lest the suprascapular nerve be injured; that the rib should be attacked as near to the vertebral column as possible and then cut through at its base: this should be done preferably from behind forward, and the rib should be freed by dissection and the anterior end dealt with last of all.

It is important that the ends of the stumps left should be as small as possible: they should be rounded off by rongeurs to avoid pressure on the adjacent structures and to avoid setting up pain.

The rib *with its periosteum* must be removed: although this makes the operation much more difficult, it is necessary because new bone may form after subperiosteal dissection, and the symptoms may recur, as in Webber's and Beck's cases. Percy Sargent, however, states that division of the continuing fibrous band is often sufficient, and that removal of the rib is not always necessary.

The Operation.—There are three methods of approach for the removal of a cervical rib—the anterior, the lateral, and the posterior.

The *anterior route* is the most difficult: it is practically the same as that employed for ligating the subclavian artery.

The *lateral route* of Thorburn calls for a vertical or hockey-stick incision over the anterior edge of the trapezius, the dissection being carried out between the posterior border of the scalenus medius and the levator scapulæ muscles: the plexus is more or less protected by the thickness of the scalenus medius, but care must be taken to avoid injuring the nerve to the serratus magnus, as it pierces this muscle.

The *posterior route* calls for a vertical incision one inch from the spinous process, with its center at the level of the seventh cervical spine: the trapezius is reflected forward and the rib exposed from behind. The rib is first detached from the transverse process and body of the vertebra: it can then be readily controlled, and the artery and nerve can be pushed forward.

Among the structures that may be injured during the course of the operation are the brachial plexus (postoperative paralysis may arise without any obvious injury to the plexus during the operation); the posterior thoracic nerve, the nerve to the rhomboids, and the suprascapular nerve; the thoracic duct (in left-sided operations and especially by the anterior route); and the pleura, causing pneumothorax: opening of the pleura is not as a rule followed by bad results.

In the **postoperative course** more or less severe pain in the neck, shoulder, or arm may arise: this usually lasts for from one to three months. The paralysis that occurs without any obvious nerve-injury at the time of operation is fortunately only temporary: it usually clears up in from two weeks to four months.

As to the **postoperative results,** in Thorburn's list of 20 cases pain was cured in 12 cases (80 per cent.) and relieved in 3 (20 per cent.): the remaining 5 patients could not be traced. Paralysis was cured in 5 (50 per cent.) and relieved in 5 (50 per cent.). The impairment of sensation was relieved in all, but cured in none; tactile sensation usually becomes normal, but some alteration in the temperature-sense is liable to persist. Marked improvement after operation takes place, as a rule, if the operation has not been delayed too long. Wasting usually persists. Occasionally elongation of the transverse process of the seventh cervical vertebra, or acute angulation of the first thoracic rib at its junction with the transverse process, produces the same symptoms as a true seventh cervical rib. We have operated upon a number of cases of these types with gratifying results.

HEMORRHAGIC DURAL CYST—ABLATION.—BIBLIOGRAPHY OF INJURIES AND DISEASES OF THE SKULL AND MENINGES

Summary: Clinical history of patient; discussion by Dr. Mix; comments—diagnosis of cause of unconsciousness; clinical course of epi- and subdural hemorrhage when unrelieved; evolution of operation of resection of thickened dura; operation—osteoplastic trepanation; pathologic findings; ablation of cyst and excision of dura; postoperative comments—occult nature of certain brain-lesions; prophylaxis of late sequelæ of middle meningeal hemorrhage; postoperative prognosis; the convulsion stage; addendum—case illustrative of latter; hemorrhage from lacerated dural sinus. Bibliography of injuries and diseases of skull and meninges.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-eight years of age, was admitted to Mercy Hospital December 13, 1915. The family history reveals that the patient's father died twenty-eight years ago from laryngeal tuberculosis: there is no history of malignant tumors. The patient's past history is negative.

Over two years previous to admission, on October 13, 1913, while motoring at a speed of 25 miles an hour, the patient was thrown out of the machine, landing on his head and receiving a lacerated wound in the left temporal region, 2½ inches above the zygomatic arch. He was immediately rendered unconscious and remained so for thirteen days, exhibiting diplegia of the extremities during the entire period. At the end of the thirteenth day the patient began moving the right upper and lower extremities, and two days later the left; while six days after this—three weeks from the time of the accident—he was able to talk: none of these motor acts could be performed normally, however, until January 10, 1914—three months after the accident. The powers of memory and speech improved until ten months ago, when they became stationary, and no further improvement has occurred.*

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* Note how closely this portion of the history corresponds to the description of recovery from concussion in the quaint words of Sir Charles Bell: "When a patient is recovering from the effects of concussion, the mind is for a long time very irregularly exerted; there are confusion of ideas and partial loss of memory. Sometime she remains *long silly;* or his speech is affected, or his limbs are feeble and almost paralytic." (*System of Operative Surgery*, 1816, 370.)

At present the patient's memory is very poor; it is hard for him to express himself; he is quick-tempered and becoming more irritable. The patient is generally weak, but suffers from neither cough nor night-sweats.

Examination by Dr. Murphy (December 13, 1915).—Inspection reveals atrophy of the temporal muscle below the site of the lacerated wound and irregularity of the calvarium at that site. The skiagram reveals a clean-cut linear fracture of the skull on the left side, but whether or not this fracture involved also the base of the skull is not determined by the picture.

The pupils react to both light and accommodation; Romberg's sign is present in slight degree; the tendon-reflexes in all four extremities are normal.

COMMENTS

Dr. Murphy (December 15, 1915): The burning question is, What was the cause of the prolonged unconsciousness? Was it contusion of the brain from the concussion, compression from a depressed fragment, or compression from hemorrhage with blood-clot formation? If a hemorrhage, was it epidural or subdural? Dr. Mix will present the neurologic and psychic elements of the case.

Dr. Mix: The patient was injured over two years ago by being thrown from a motor, his head striking a steel rail: he received a deep cut and depression 2½ inches long across the forehead and left temple, the scar of which is plainly visible. The skiagram apparently shows a linear fracture at this point. The patient was immediately rendered unconscious and remained unconscious for thirteen days. There was no hemorrhage from eyes, nose, mouth, or ears, and no hematomata formed upon his neck. Nevertheless, such a long period of unconsciousness leads one to suspect subdural hemorrhage.

As a rule, the unconsciousness of subdural hemorrhage is not immediate. We have the history of a blow, followed by a short period of consciousness, and then, by the gradual accumulation of pressure due to the poured-out blood beneath the dura, consciousness is lost, so that in many histories we find the patient is not completely unconscious until fifteen minutes or a half-hour after the blow upon the head. On the other hand, if the unconsciousness is due to a concussion, it is usually immediate. In a great many instances, however, we have a combination of both concussion and subdural hemorrhage. Unconsciousness, the immediate effect of the concussion, is generally recovered from within a few hours. If, however, besides the unconsciousness from concussion there also follows unconsciousness from subdural hemorrhage, frequently the loss of consciousness is maintained until the hemorrhagic exudate is partly absorbed, thus relieving pressure. In this case it is a fair inference that we have to deal with both concussion and subdural hemorrhage, the former being responsible for the immediate unconsciousness and the latter for its prolongation. It is possible that the prolongation of the hemorrhage may be due to a depressed fracture of the inner table, but the skiagram does not support this deduction. We would, therefore, conclude that this patient's long period of unconsciousness (thirteen days) is fairly good evidence of a subdural hemorrhage of considerable degree.

The symptoms which one encounters depend upon the location of this hemorrhage. In this individual no paralysis followed recovery. In other words, the hemorrhage could not have taken place over the precentral gyrus, the site of the motor cortex, but over a part of the brain not presided over by the motor function. Most of the symptoms concern the frontal lobe of the brain. We find loss of memory, loss of judgment, disturbance of speech, excitability, and a state of mind so highly irritable that the patient becomes angry at trifles. The disturbance of speech is not due to dysarthria, because he articulates perfectly well, but is amnesic aphasia: he cannot recall the words he wants to use, and so hesitates in his speech. He can speak the word when he gets it in mind, but the trouble consists in locating the word.

Closely associated with this amnesic speech aphasia is amnesic motor aphasia, or *amnesic apraxia.* The history reveals the highly significant statement that the patient actually forgot how to brush his teeth and how to tie his cravat. This seemed to him very strange, and he commented upon it. He said he had to re-learn the successive movements required to tie his cravat, as well as brush his teeth. It is not possible for us to execute complicated movements in proper sequence unless we have stored up a motor memory. These motor memories we draw upon when we wish to execute movements, and we succeed in our purpose. One who learns to play the piano without his notes is aware of the fact that his fingers learn the sequence of notes where even his brain forgets. In other words, there is established in the motor cortex, independently of an actual knowledge of the notes, a complicated set of motor memories which are automatically thrown into action in the playing of a piece committed to memory: the player remembers not the notes, but the movement-complex. When, therefore, this patient was unable to tie his cravat or to brush his teeth, some lesion must have interfered with the stability of his motor memories for such complicated acts. These motor memories probably lie close to the motor cortex in the frontal lobe, so that from loss of ability to brush his teeth and tie his cravat we may infer that there has been some interference with the frontal lobe of the brain.

The same thing applies to his amnesic aphasia. He can talk mechanically correctly, but cannot remember the words which he wishes to make use of. It is thought that the site of these various motor memories lies close to the motor speech center in the left inferior frontal convolution, which has been named after the discoverer of its function, in 1868, "Broca's convolution."

We believe that injuries of the frontal lobe are particularly prone to cause irritability and excitability. The famous crowbar case, which is a medical classic, is an instance of this. We further believe that the center for judgment also is to be found in the frontal lobe. Since all this patient's symptoms point to the anterior portion of the lower part of the frontal lobe,—exactly at the site of the injury,—operative interference is advisable.

The physical examination is negative: tendon reflexes and superficial reflexes are normal; pupils are equal and react to light and accommodation. There is neither motor paralysis nor sensory loss; nor defect of sight, hearing, or smell. The motor cranial nerves—the third, fourth, sixth, seventh, and twelfth are all intact. There is no Babinski reflex, Gordon reflex, Brudzinski reflex, or anything to indicate involvement of the upper motor neurons or of the motor cortex in the precentral gyrus. The symptoms consist of abnormal psychology, abnormal irritability and excitability, loss of motor memory both for speech and acts, motor aphasia and motor apraxia, and loss of judgment.

We have not thus far mentioned the absence of convulsions. Although convulsions probably will not follow at this late date, yet we cannot conclude that because there have been no convulsions within two years' time, none will take place, for cases have been observed in this clinic in which convulsions have followed the accident after several years of quiescence. Our reason for believing that convulsions are not liable to follow lies more in the location of the lesion than in the time elapsed. A lesion not close enough to the motor cortex to produce motor phenomena at the time of the accident will not be liable to cause convulsions at some subsequent time. I do not say that this is not possible: I simply state that it is not liable to occur.

Why should operation be performed? There are two reasons: one is the possibility of clearing up the motor aphasia which has partly incapacitated the patient from work. At the time of the injury he told me that he was the circulation manager for a large newspaper in Los Angeles, and that, after recovering from the accident, he tried to do his work again, but was so irascible that he could not get along with his various agents. On this account he resigned. He has not been able to do any work since because of his great change in manner. If he could be cured by operation, he would undoubtedly again become a very successful business man.

The other reason for the operation is not so good: it is for the possible relief of convulsions in the future. So long as there is any chronic disturbance of the cortex, either from a cyst or from an organized subdural clot with a thickened dura, there is a possibility in the future of a sufficiently long-continued irritation to bring out an epileptic tendency.

We ordinarily expect one of two things: either thickening of the dura from organization of an old clot, or a cyst beneath the dura in the cortex. In all the recent cases except one we have found no cyst, but a thickening of the dura. With such a long period of unconsciousness a cyst is more likely than a subdural thickening.

* * * * * * *

Dr. Murphy: In ancient cases of clot-formation the clot may become encapsulated by connective tissue, giving rise to a "hemorrhagic cyst," which may be epidural or subdural in location. Such a cyst may remain stationary or become more and more absorbed and cicatricial. In a very able paper the late Dr. Dudley Allen, of Cleveland, reported a large series of cases of asylum-patients who, after a hemorrhage years before, developed first convulsions and later mental deterioration, which drove them into the asylum. At operation there were found small and at times large cysts, which had become encapsulated and remained years after the hemorrhage. Many years may elapse between the time of receipt of the trauma and that of the onset of convulsions: these rarely appear within a few months—much more frequently, in our own experience, within from twelve to thirty months,—and may be delayed even so long as from twenty to twenty-four years after the receipt of the trauma. [Cites case in which convulsions did not appear for twenty-two years (see vol. iv, August, 1915, 639).] . . . We attribute the convulsions to involvement of the dura, which may be adherent to the skull or to the brain.

Contrasting our present with our former methods of operating upon these cases, during the eleven-year period from 1883 to 1894 our decompression-operations consisted of resection of the skull without disturbing the dura. In 1894, however, we began to remove the irritated portion of the dura, and feel that our results have been materially improved by this change in technic. [Cites case illustrating beneficial effect of removal of dura—see vol. iv, August, 1915, 641).] . . . At one time it was a fad to resect a portion of the underlying brain-cortex together with the dura, but this fad—which was advocated even by Roswell Park—soon died out; at no time did the procedure appeal to us, for we felt that it was better to wait until the problem was fully worked out, so great was the mortality of the operation. I believe that in this respect all operators have receded to the position taken by Brown-Séquard,—the successor to that great physiologist and vivisectionist investigator, Claude Bernard,—who, when I was a student at the Rush Medical College, demonstrated on pigeons dural irritations as an etiologic factor in the production of convulsions. These experiments were a factor in confirming our change in technic in resecting large areas of irritated dura, in addition to resecting the skull.

OPERATION

One of the unpleasant sequelæ of trephining is that of necrosis of the flap-margins, and in outlining the latter I shall try to preserve as much blood-supply through its pedicle as is possible. [Outlines horseshoe-shaped flap with base below; incises scalp and retracts flap-edges of scalp a short distance to line of intended bone-section; with Neff trephine cuts through skull except at base of flap; fractures osseous layer opposite base and reflects resulting osteoplastic flap downward.] . . . Now you can see in the exposed operative field the line of fracture, a point of bleeding, the altered dura, and the bulging of the underlying brain. The fracture has resulted in an indentation of the skull. The bleeding is from the posterior branch of the middle meningeal artery: I am checking it by the use of bone-wax. The dura is not firmly adherent to the skull: it is white from cicatricial changes and does not pulsate. [Excises diseased area of dura 2 by 1¾ inches by an incision just short of line of bone-section.] . . . . The bulging of the brain indicates increased pressure of the cerebrospinal fluid.

You now see a hemorrhagic cyst of the type which I have just described (Fig. 44): it is the legacy of a subdural hemorrhage and has irritated the dura considerably; the surrounding blood-vessels are greatly dilated. [Opens cyst; wall of cyst collapses; ablates wall of cyst.] . . . The bulging that was previously present has now subsided. As in gasserectomy, we control the oozing by gentle pressure plus "tincture of time": it is important to control bleeding before closing the wound in order to prevent another hematoma from forming, and, as a further precaution, in closing the wound we shall provide a little track through which blood may escape *externally* instead of accumulating beneath a tightly sealed flap. [Replaces osteoplastic flap; sutures temporalis with galea and subcutaneous fatty layer of scalp.] . . . As I remove the scalp-forceps slight oozing arises from the released soft tissues. [Inserts skin-sutures and applies large gauze dressing covered with starch.]

POSTOPERATIVE COMMENTS

Brain lesions are not always so satisfactory from the standpoint of operative surgery as this one, in which we were able to locate a definite physical cause for the symptoms: often one performs cerebral decompression without the pathologic lesion being revealed. The thickened, unyielding dura and the hemorrhagic cyst pressing upon the cerebral cortex formed just the right setting for convulsions to arise.

What can be done by way of prophylaxis in such a case at the time of injury? Given the physical signs of active and continued hemorrhage from the middle meningeal artery,—a branch of the internal maxillary division of the external carotid,—*all that is necessary for its prompt control is to expose the external carotid parent trunk opposite the greater cornu of the hyoid bone and tie it* (vol. iv, August, 1915, 627, et seq.). The clots that have already formed may be removed later.

In this case it is possible for a convulsion to occur after operation: should that happen, *do not delay;* on account of the already desperate condition of this class of cases *re-operate immediately* and remove the cause of the pressure upon the cortical area.

The mortality of such an operation as we performed today is not over 20 per cent.: we are therefore justified in operating upon this patient, for had he not been relieved of the cortical irritation, he would eventually have had to be committed to an insane asylum—the saddest fate that a human being could suffer. Death is nothing: an asylum is horrible.

This patient could have been spared the two years of mental and physical suffering if, at the time he received the compound

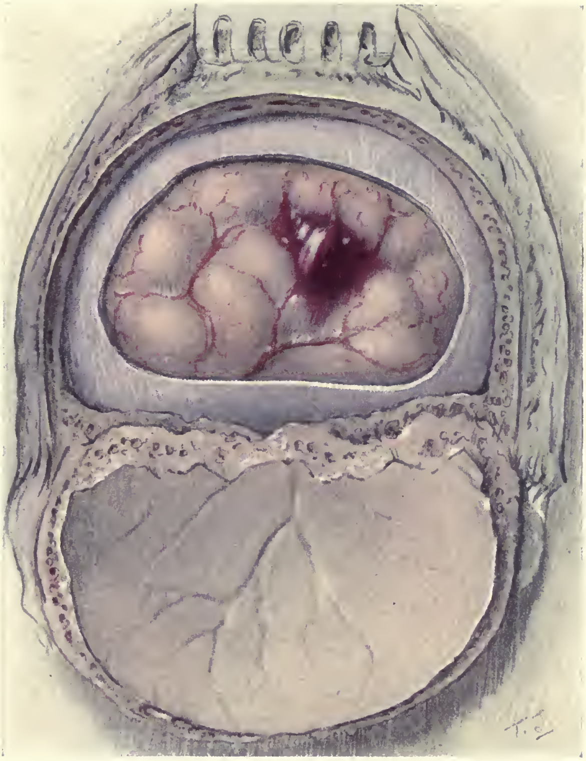

Fig. 44.—Hemorrhagic cyst shining through pia mater encephali.

fracture, the wound had been enlarged and the bony fragments and clots removed. In the absence of localizing symptoms operation should be performed as soon as headaches manifest themselves.

Once the convulsion-stage is entered upon, the results of operation become very unsatisfactory: of patients who have been operated upon because of convulsions only 5 per cent.—1 out of every 20—pursue a convulsion-free postoperative course; this is a very small reward for the sum total of the operative work that has been performed upon these cases. The percentage of amelioration, however, is much greater than that of permanent cure, for from 30 to 40 per cent. of the patients obtain postoperative relief through diminution in the frequency and severity of the convulsions.

Postscript (*January 25, 1916*).—The patient recovered uneventfully and left hospital four days ago. There was no return of the headaches, nor were there any convulsions. The speech had greatly improved.

Addendum.—Convulsions, the result of a similar accident, occurred in the case of a male, forty-one years of age, who, on November 15, 1913, was riding at the rate of 40 miles an hour in a motor when it turned turtle. Five hours later he was picked up unconscious and remained *in statu quo* for the succeeding ten days. There was a slight scalp wound over the right parietal bone; right hemiplegia and aphasia.

About three weeks later speech began to return, and one month after the accident the patient began to use his right foot: he has never regained the full use of his right arm, however.

Five months after the accident convulsions made their appearance and continued until the patient was operated upon. A typical attack was inaugurated by twitching of the right eye, drawing up and twitching of the leg and then of the arm on the same side; consciousness was not lost, and the patient did not "froth at the mouth"; the duration was about one minute, and after each attack the patient felt nervous. During the last two months the convulsions have involved all four extremities.

Examination revealed feeble reflexes in the lower extremities.

At operation, April 30, 1915, a whitish, thickened patch of dura two inches square was excised, and a free transplant of fascia lata and fat substituted for it and inserted beneath the cut edge of the remainder of the dura to prevent the latter from contracting adhesions to the inner surface of the osteoplastic flap or the outer surface of the brain (see vol. iv, August, 1915, 637). In reference to transplanting fascia lata with or without fat into the dural defect Dr. Murphy stated that he believes that it has a beneficial effect, but that the method had not been employed long enough for one to draw conclusions as to the ultimate effect upon the patient.

Dr. Murphy related the case of a patient who impaled his skull upon a large railroad spike after being thrown from a horse: elevating the fragments he found a punctured wound the size of a finger in the superior sagittal sinus, from which blood flowed with a gush. The pressure in a sinus with the patient in the recumbent posture is plus, except on deep inspiration, where it is minus, and to control it merely a little more than a plus pressure is required: this was supplied by a simple gauze packing which was permitted to remain for seven days.

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II. Extradural Hemorrhage from Trauma—Excision of Dura: vol. i, June, 1912, 437–49.

III. Traumatic Epilepsy—Decompression: vol. i, August, 1912, 547–52; vol. iii, October, 1914, 931–43; *vide supra*, p. 249.

IV. Hemorrhagic Cyst of Dura—Ablation: vol. iv, August, 1915, 615–34; *vide supra*, p. 241.

V. Tuberculous Meningitis: vol. iv, August, 1915, 643–45; *ibid.*, 647–59 (Leptomeningitis and Ependymitis).

VI. Cerebellar Tumor—Suboccipital Decompression: vol. ii, April, 1913, 295–303; vol. iii, August, 1914, 805–815; vol. ii, August 1913, 739–47 (Glioma Encroaching upon Fourth Ventricle—No Operation Performed, but Pulmotor Used).

PHLEGMON OF SPINAL CORD (CONUS MEDULLARIS)—INCISION AND DRAINAGE. DIAGNOSTIC DISCUSSION BY DR. MIX

Summary: Clinical history of patient; comments—discussion by Dr. Mix; operation—types of metastatic infection involving spinal cord; exposure of phlegmon by laminectomy; presence of pus coincides with interpretation of clinical history; insertion of drainage; accurate closure of wound; postoperative comments—value to internists of demonstrations of living pathology; prognosis; some recent bacteriologic experiments.

CLINICAL HISTORY OF PATIENT

A FEMALE, twenty-five years of age, was admitted to Mercy Hospital December 3, 1915. The family history reveals that one brother died two years previously of Pott's disease after an illness of seventeen years. The personal history reveals that six years previously, in 1909, the patient was operated upon for the removal of several slightly enlarged cervical lymph-nodes.

Six months ago, in June, 1915, the patient consulted a physician in regard to slight cough with early morning expectoration and loss of weight (21 pounds): she did not expectorate blood nor did she sweat at night. Examination of the apex of the left lung revealed slight dulness and diminished breath-sounds; examination of the sputum did not reveal the presence of Bacillus tuberculosis. Institution of dietetic and hygienic measures resulted in disappearance of the cough and gain in weight.

About three months ago, on August 28, 1915, the patient went north for a week's stay in the woods. On August 29th she had a pain in the left side of her chest, just under her breast. It hurt her when she took a breath. She did not spit blood, had no fever, and was not dyspneic or cyanotic. The next day the pain disappeared. She returned home September 4, 1915. September 6th was a cold, rainy day and she spent the afternoon with a girl friend sitting on the porch. She became chilled through, but did not have a distinct chill. Tuesday, September 7th, while walking upstairs, she had pains which she likened to growing pains in the calves of her legs, radiating down toward the heel. Her legs felt weak and tired. These pains became sharp, shooting in character, and grew worse during the night. Wednesday morning, September 8th, she consulted a physician who diagnosed neuralgia. The pains grew worse Wednesday night and involved her thighs. They were sensitive to touch. That morning the physician gave her a hypodermic to relieve her, and repeated it at 7 P. M., after she had complained of severe pains in the abdomen. Thursday, September 9th, about 5 A. M., she tried to get out of bed and found that her legs were paralyzed and that she was numb from the waist down. A little later she found that she had lost control of the rectum and bladder. She had no feeling in her legs, which, when placed in one position, remained that way. The physician states that there was complete paraplegia, loss of reflexes, sensory and motor paralysis. Examination of the spine revealed nothing except slight tenderness over the ninth and at times the tenth and the eleventh thoracic vertebra. She was taken to hospital, when she vomited several times and continued to vomit for a week. She had a severe headache about her eyes and the back of her head, for which she was given hypodermics twice. Her neck was stiff, so that she could not sit up straight in bed. The physician states that her temperature rises occasionally to 99.5° or 100° F. in the evening. Her condition remained about the same until her entrance here. At present she has a tingling sensation in her limbs after massage.

Examination by Dr. Murphy (December 7, 1915).—There is marked edema of the lumbar zone on a level with the first lumbar vertebra. The patient appears to be suffering from acute metastatic infection of the spine. The cerebrospinal fluid contains 35 cells in each cubic centimeter.

COMMENTS

DR. MURPHY (December 9, 1915): The typical acute onset of this case showed in the most marked degree the *acute*, *sudden* manifestation which is indicative of so many types of metastatic infection that one only needs locate the tissue or organ in which the infection is localized.

There are many metastatic spinal-cord abscesses secondary to fracture-luxations of the vertebræ where the injury is followed by decubitus, cystitis, nephritis, etc.

Puncture of the spinal canal in this case did not yield a yellow fluid, nor did the fluid coagulate, showing that there was not a complete closure of the subarachnoid space at the point of infection, such as occurred in the case of spontaneous massive coagulation of cerebrospinal fluid with xanthochromia, which was reported in vol. iv, April, 1915, 317–382.

From the speed of advancement of the symptoms in this case one is forced to the conclusion that it is one of phlegmon of the spinal body on the spinal canal side, with rupture of the pus into the lumen of the spinal canal compressing the cord. Dr. Mix will present the localizing findings in the case.

Dr. Mix: You have heard the history by the intern. The patient is a young woman, twenty-five years of age, somewhat pale and quite thin. She gives one the impression, however, of weighing about as much now as she weighed for some time back. We find in her history two very important points: first, that she lost a brother of Pott's disease after an illness of several years; and, second, that she herself was said to have had pulmonary tuberculosis in June, 1915. At that time she suffered somewhat from cough and morning expectoration, but there was never any blood in the sputum and she had no night-sweats. So far as she knows she had no fever. The loss of weight was slight, being but 2½ pounds. The physician in attendance was of the opinion that there was a tuberculous lesion in the apex of the left lung, but several examinations of the sputum failed to show tubercle bacilli.

On account of this illness the patient, who lived in a town in middle Wisconsin, was sent into the northern woods to spend the summer. It was thought that if she were out-of-doors she could regain her lost health. She tells me, however, that she gained only two pounds, so that at the end of the summer her weight was approximately what it was the first of June. At the end of August, in order that she might be kept out-of-doors more than she otherwise would be, it was planned to give her a three-day automobile trip. She left on the twenty-ninth of August, which was a cold day, and she rode a great many miles the first day. She remarked to her husband, as they got out of the machine at night, that for once in her life she had had all the automobile riding she wanted. She was so thoroughly chilled that it took her until the next morning to get warmed up. Immediately following this exposure she noticed pain in the left side of her chest, beneath the breast. When she took a deep breath it hurt her. Presumably, the pain was due to pleurisy. The pain, however, disappeared within another day or so, and she considered herself as well as ever.

She then returned to her home and remained in her usual health until Labor Day, which was cold and rainy. In the afternoon, while her husband was playing cards with a friend in the parlor, she and a girl friend spent the afternoon on the porch; she remained out upon the porch until again she became chilled through and was forced to go inside. Late that afternoon and in the evening she was bothered with chilly sensations. She cannot say that she had a distinct chill lasting several minutes, but she noticed that she had chilly sensations of noticeable intensity.

The next morning, Tuesday, September 7th, when she awakened, she as bothered with pain in her heels and calves. The pain she describes as shooting. During the day the pain grew steadily worse. By night she complained further of a feeling of weakness and fatigue in both legs. She went to bed Tuesday, September 7th, twenty-four hours after the onset of the chilly sensations, feeling very uncomfortable indeed. She passed a bad night, and Wednesday, September 8th, sent for a doctor the first thing in the morning. When the doctor came the pain in her legs was so bad that he was forced to give her a hypodermic injection to relieve her. He told her that her trouble was neuralgia. During all Wednesday the pain increased in severity, passing up the thighs, then to the lower abdomen; and, furthermore, and very important, a feeling of numbness began to appear in the toes and in the feet. At 7 P. M. the doctor returned because of the continuation of the very severe pain, which had reached the abdomen, and gave her a second hypodermic injection. Wednesday night she was miserable. She remembers that she slept very little, but she cannot remember distinctly the condition of her legs until 5 o'clock in the morning. At 5 o'clock Thursday, September 9th, sixty hours after the onset of the trouble, which occurred at 5 P. M. Monday, September 6th, she started to get out of bed and found, to her great surprise, that her legs were both paralyzed. She also made the discovery that she had no feeling from her waist down. The reason that she tried to get up at 5 A. M. Thursday morning was that she wished to empty her bladder. Very shortly after this she lost control of her bladder and rectum.

The salient points in the history up to this time are the chill, the shooting pains upward from the heels to the calves, thighs, and lower abdomen, the very *rapid* spread of the pain upward, the feeling of numbness reaching as high as the waist-line, the paralysis of both legs, and the loss of control of the sphincters of the bladder and rectum. Up to this point we have no record of fever.

Owing to her very grave condition the patient was then taken to a hospital and thoroughly examined. There it was found that she had no knee-jerks, and that she had a very severe and wide-spread sensory and motor paralysis. Examination of the spine showed slight tenderness between the ninth and eleventh thoracic vertebræ. While she was at the hospital observations of the temperature were taken, and it was found that she ran a little fever each day, the temperature, as a rule, not rising above 100° F. While she was at the hospital another set of symptoms developed, namely, severe headache above her eyes and in the occiput and severe attacks of vomiting. With these, we are told, there was considerable stiffness of the neck. Headache, vomiting, and cervical rigidity constitute a trio of symptoms almost pathognomonic of meningitis.

Inasmuch as the patient's condition had not improved at the hospital where she was, it was decided to bring her to Chicago. She entered Mercy Hospital December 3d, and at 6 P. M. had a temperature of 99.6° F. The next day, on the fourth, her temperature reached a maximum of 100.4° F. On the fifth I ordered a tuberculin test, giving her 5 minims of the third dilution at 5 P. M. The maximum temperature the day after its administration was 101.4° F. at 9 P. M. The following night a temperature of 101° F. was reached at midnight. Inasmuch as the temperature following the administration of the tuberculin was not much in excess of the temperature reached before its administration, it was not felt that the test could be looked upon as positive. A blood examination made on the fourth showed 3,900,000 erythrocytes, 70 per cent. hemoglobin, and 9800 white cells per cubic millimeter. On the sixth the leukocyte count was reported as 10,200, and on the seventh as 12,420.

We are now ready to consider the *physical findings*. On examining her reflexes we find that the ankle-jerks and patellar jerks are wanting on both sides; that the abdominal reflexes, both epigastric and hypogastric, are absent. We find further that there are no abnormal reflexes, such as the Babinski reflex or the Brudzinski sign. On the other hand, the reflexes of the upper extremity are in perfect condition and the jaw-jerk is normal. The change in the reflexes, therefore, is confined to the reflexes of the abdominal wall and the lower extremities. Furthermore, the loss of the reflexes indicates that the type of disturbances is that affecting the lower motor neurons. When the upper motor neurons are involved, the reflexes are increased and pathologic reflexes are present. On examining her motor power, we find that she has a paralysis in both legs. On asking her to draw in the abdominal wall, we find that she is unable to innervate the external or internal oblique or transversalis. The only movement of which she is capable is the contraction of the diaphragm. In looking further into the paralysis of her legs, we note that it is of the flaccid type and that there is a double toe-drop. Such a paralysis, flaccid in type, with lost knee-jerks, means a paralysis of the lower motor neurons.

Sensation, we find, is involved in a very curious way. She cannot feel touch at all in her legs, but when you attempt to examine carefully into the sensory disturbances of the abdominal wall, one finds that she feels touch at a point on a level two inches below the navel, but that it does not feel natural. In other words, over the tissues adjacent to the navel she is conscious of touch, but she is not conscious of the quality of the touch. The epicritical but not the protopathic sense is lost. We find that loss of the epicritical sense extends upward to the point of supply of the seventh thoracic segment of the cord. Besides these sensory disturbances, she complains of short stabbing pains, especially of pains of an irregular type, which she occasionally *feels in her legs*, and of a burning in her legs, especially after she has had a bath or if the legs have been massaged vigorously. She apparently has, therefore, some fibers in the columns of Gower and in the lateral columns of the cord, which are transmitting pain impressions from the lower extremities. She apparently, however, has no fibers which carry purely tactile impressions from the extremities up through the cord.

On examining into trophic disturbances we find first a very deep bedsore, about 2½ inches in diameter, over the lower part of the sacrum, and just over the point of junction of the sacrum and coccyx. This bedsore is a very sluggish and a very deep one, being more than one-fourth of an inch deep. Besides this trophic disturbance, we also note an atrophy of the muscles in both lower extremities, especially in the territory of the sciatic nerve supply. The gastrocnemius and soleus muscles, for example, and all the muscles of the posterior tibial group, are somewhat atrophic. The same is true in a lesser degree of the anterior tibial group. We also note—and possibly this may be considered very important—an *edema* over the lower part of the back, in the region of the eleventh and twelfth thoracic vertebræ. This edema was noticed when the spinal puncture was made and was very distinct, so that it forced itself upon one's attention. Lastly, there are marked bladder and rectal disturbances, the loss of control being complete and having been so from the ninth day of September to the present time.

A lumbar puncture after the patient entered the hospital showed 35 cells to the cubic centimeter. The Wassermann reaction was negative, using two antigens. There was, however, a positive Noguchi, indicating protein in the cerebrospinal fluid and being suggestive of a meningitic process.

With these data we are now in a position to discuss the question of *diagnosis*. First of all, there is one very important group of symptoms which perhaps is of vital importance in this case, namely, the "osteomyelitic syndrome," if one may use that expression. The girl was in perfect health on the day before Labor Day. She had had, on the twenty-ninth of August, a slight pain involving her left chest, preceded by chilling of her body. She had apparently gotten well of this. A second exposure on Labor Day was followed by definite chilly sensations, leading, in sixty hours' time, to a complete development of a paraplegia. No matter where this syndrome is found, it always means the same thing: it means a metastatic purulent infection. We meet with it usually as an osteomyelitis, a focus of pus developing suddenly within a bone. We find the same thing in various abscesses and in purulent exacerbations in various organs. This syndrome makes us wonder, in this case, whether there could possibly have been a sudden focus of pus so placed in the bodies of the thoracic vertebræ as to cause compression of the cord and paralysis in sixty hours. We, therefore, had some *x*-ray plates taken, but they did not show anything in the bodies of the vertebræ. In fact, it did not seem reasonable to us to assume that a purulent focus could develop in the bodies of the vertebræ and reach such proportions as to be able to cause sufficient compression of the cord to produce complete paraplegia within sixty hours' time. In view of these *à priori* considerations, and also of the negative *x*-ray plates, we speculated as to whether it might not have been possible for a focus of infection to have taken place within the spinal canal, possibly in the fatty tissue just external to the dura mater. Just before this patient was brought to the operating room this morning Dr. Murphy said to me that, *no matter where this picture of sudden chill, fever, pain, and leukocytosis is found, it must always mean the development of a focus of pus.* I think there is no doubt of the truth of this statement.

As to the localization of this trouble, we are confronted with some very serious difficulties which make the case quite interesting. First, we have very definite proof of the involvement of the cauda equina. This is definitely proved by the loss of the knee-jerks and ankle-jerks, the flaccid paralysis, and atrophy of the muscles of the lower extremity, particularly of the anterior tibial group. *Lost knee-jerks, flaccid paralysis, and muscular atrophy are a trio of symptoms always indicating disease of the lower motor neurons.* It may be that the disease affects the peripheral nerves after their escape from the intervertebral foramina, or it may be that the disease affects the nerve-trunks anywhere between the point where they leave the spinal cord and the point where they enter the intervertebral foramina; or, indeed, it may happen that the disease affects the cells themselves in the anterior horn. If the cells of the anterior horn are involved, we call the process an anterior poliomyelitis. If the nerves are affected within the spinal cord, it is usually because of leptomeningitis, either acute or chronic. If it happens that the nerves within the spinal canal, which are grouped in the cauda, are affected, then we call it caudal disease. If it happens that the nerve-trunks are affected after they leave the vertebræ, via the intervertebral foramina, then we call the trouble peripheral multiple neuritis. In all four cases the disease amounts to the same thing—an involvement of the lower motor neurons; and in all four cases the symptoms are the same, namely, flaccid paralysis, lost knee-jerks, and muscular atrophy. In this particular case, since the reflexes of the lower extremities alone are entirely gone, since there is muscular atrophy of the lower extremities, and since there is flaccid paralysis, we must conclude that there is an involvement of the cauda equina. Were it peripheral multiple neuritis, the upper extremities would also be involved, but they are entirely free.

Let us now turn to another phase of this case. We find that during the first week of the illness the patient had severe occipital and frontal headache, associated with vomiting and with stiffness of the neck. Rigidity of the neck alone should arouse a suspicion of meningitis. In this particular case one feels positive, in view of these signs and the fever, that meningitis existed. Moreover, we felt so positive that meningitis had existed in her case that we were certain that a lumbar puncture would give us positive information as to the possible continued presence of that meningitis. The cerebrospinal fluid showed 35 cells to the cubic centimeter and showed, furthermore, by the presence of protein in the cerebrospinal fluid, the existence of meningeal inflammation. We must assume, therefore, that this caudal disease is not and cannot be due to mere compression from osteomyelitis affecting the bodies of certain vertebræ. We are compelled to conclude that there must have been and still is some disturbance of the meninges as they cover the caudal roots. We must assume—and we do believe—that at the beginning this meningitic process extended all along the spinal cord clear to the brain, that it was responsible for the headache and vomiting and for the cervical rigidity. The intensity of this meningitic disturbance rapidly lessened, the head symptoms entirely disappeared, and the cord-signs alone remained.

The most prominent of these cord-signs are the root-pains. We call them root-pains because they are always of a certain type, namely, that which is found in locomotor ataxia. The pains are described as having been shooting and neuralgic in character, very intense, requiring two hypodermic injections of morphin on the second day of the illness. She herself applied the term "shooting" without any suggestion on our part. Indeed, almost any patient is apt to describe these pains as shooting, boring, lancinating, jabbing, stabbing. They often say they feel as if they were made by a knife, poker, or stiletto. They are not continuous. They come and go in a moment and are repeated again and again. They often make the patient cry out just for an instant. The patient says, "Oh!" or something of the sort, and the pain is gone. Whenever one encounters such a history, one should always remember the possibility of meningeal involvement of the posterior nerve-roots. The lancinating pains of tabes are due to such a cause. The lancinating pains of compression-myelitis are due to irritation of the posterior nerve-roots by direct pressure, and in disease of the cauda the very severe pains that are occasionally met with are due to leptomeningitis of the cauda. This is the basis upon which we explain the pains in this case. We believe that there is a leptomeningitis of the cauda, being further influenced in our belief by the laboratory findings of the cerebrospinal fluid. For that reason we anticipate that the dura will have to be opened.

The last difficulty in the diagnosis in this case—though at first a seemingly important one—is in a measure explained from what I have already said. I allude to the level of the epicritical loss of sensation: this, as I stated to you in the physical findings, was at the level of the seventh thoracic segment. How can the patient have sensory disturbances originating as high as the seventh thoracic segment of the cord associated with a caudal leptomeningitis? I think the explanation of this curious phenomenon lies in the fact that the meningeal disturbance has extended as high as the seventh thoracic segment, but that there is not sufficient meningomyelitis to involve in any degree the substance of the cord up to that level. Certainly in this case we cannot disregard the strikingly plain indication of disease of the cauda, even though we have reason to suspect that there is an involvement of the cord as high as the seventh thoracic segment. It was because of our belief that the storm-center lies in the caudal zone that the operation is to be undertaken at the level of the conus and cauda, rather than in the lower thoracic region.

We are further confronted by another strange fact, namely, the existence of edema over the eleventh and twelfth thoracic vertebræ. This edema is very hard to explain unless we go back to our osteomyelitis theory. You will recall that the patient at the very first had tenderness between the ninth and eleventh thoracic vertebræ, as stated by her physician in the intern's history. This localized edema again raises the question of an abscess, and its location somewhere within or along the spinal canal at this level.

Can this be a compression-myelitis? We would answer "no" to this question, because there is nothing to cause such compression. The *x*-ray shows nothing in the spinal column. The onset of the paralysis distinctly resembles an osteomyelitic process, and is at complete variance with all that we know of the slow development of a compression-myelitis from tumors. In tumors of the cord we always find a sensory irritation, followed by sensory losses, and then comparatively suddenly—possibly within two or three weeks' time—the rapid development of motor paralysis: but such is not the history in this case.

Can it be a meningomyelitis? In answer to this question we are forced to take a neutral position. It is possible that it is a meningomyelitis. We have definite signs of the presence of meningitis shown in the cerebrospinal fluid, and in the headache, nausea, vomiting, and cervical rigidity at the onset. We have also signs of a possible myelitis in the paralysis of the rectum and bladder. We believe, however, that we ought to refer the paralysis of the sphincters of the bladder and rectum to the involvement of the fourth sacral nerve filaments in the cauda equina rather than to an involvement of the cord itself; but it may be that we are mistaken and that there is an involvement of the lower portion of the cord at the level of control of the sphincters, and that there is actually present a meningomyelitis. However, we feel that the automatic lesion is,—so far as localization is concerned,—primarily a caudal lesion, because of the flaccid paralysis, atrophy, lost reflexes, shooting pains, bladder and rectal disturbances, and sensory losses. We feel, however, that more than the cauda is involved, because the extension upward of the sensory loss is beyond the caudal zone, and we look upon this upward extension as indicative of a possible associated meningomyelitis.

The final question which must be asked and answered is whether this can possibly be a tuberculous infection. We recall that the patient lost a brother after a long period of illness from tuberculous disease of the spine. We know that early in June she herself was supposed to have pulmonary tuberculosis. My own examination of the left apex fails to disclose any signs of tuberculosis. Investigation by means of an injection of tuberculin hypodermically fails to show the presence of tuberculosis. Examination of the spine—both physical and by *x*-ray—shows no deviation or other signs of tuberculous involvement; and the rapidity of the onset of the disease is absolutely at variance with what we know of spinal tuberculosis. Lastly—but to me very important—there is the range of the temperature. Practically all cases of tuberculosis show a maximum temperature in the early afternoon hours—generally between 2 and 5 P. M. Indeed, in many individuals I have seen a febrile temperature lasting from 1 to 4 P. M. drop to normal as early as 6 or 7 P. M. In the case of this patient, however, we find that the maximum temperature occurs in the evening—sometimes as late as midnight—usually at about 9 P. M.

Such a temperature-chart is quite at variance with the temperature-curve of tuberculosis. Lastly, there is the question of blood count. The leukocyte count in tuberculosis is apt to run rather low; this, on the contrary, has run as high as 12,400: a leukocyte count of these proportions does not indicate the presence of pure tuberculosis. I feel, therefore, that we should not regard this case as one of tuberculous meningitis with an associated involvement of the cord.

In closing, we must come back to two fundamental facts. The first is that we have an osteomyelitic picture of onset, associated with edema in the back over the eleventh and twelfth vertebræ. The second fact is the involvement of the cauda: it is there, with its lost knee-jerks, its flaccid paralysis, its shooting pains, and its atrophy. For these reasons it has been deemed best to advise laminectomy in the region of the caudal zone, removing the laminæ of the eleventh and twelfth thoracic and the first and second lumbar vertebræ. We also feel that in view of the presence of meningitis, it will probably be necessary to open the dura.

In this connection I should like to speak of a series of five cases of a hitherto undescribed disease of the cauda equina. On opening the dura in these five cases the cauda was found involved in a meningitic process, the fibers of the cauda being red and injected with blood, and evidently in a state of chronic inflammation: it is just possible that in this case we may find such a picture of the cauda.

OPERATION

Dr. Murphy: There are two types of metastatic infection that involve the spinal cord: the pyogenic (*a*) without trauma,—the clinical history of which is presented by this patient, and (*b*) with trauma of the cord—and the tuberculous. Six years ago this patient was operated upon for the removal of several slightly enlarged cervical lymph-nodes which would suggest tuberculosis in this case. Tuberculosis of the spinal cord should not manifest itself by such a stormy course—unless a latent tuberculous process had been secondarily invaded by pyogenic microörganisms: in its rapidity of destruction a mixed pyogenic and tuberculous infection may express itself by the symptoms and signs which are indicative of a pure acute pyogenic involvement—with the exception of the high degree of fever of the latter; the former, as a rule, causes only a low degree of fever and a low leukocytosis.

[Vertical incision over thoracicolumbar region of spine.] . . . . As I separate the soft tissues from the vertebral column, you note that they do not bleed like normal tissues, and that they are infiltrated by edematous material clear down to the bases of the spinous processes. [With rongeur forceps removes spinous processes and then laminæ from lower margin of second lumbar vertebra to lower margin of tenth thoracic.] . . . The epidural space is now clearly exposed: there is less edema in the areolofatty tissue here than there was in the same tissue outside of the spinal canal; the inflammatory focus seems to be at its maximum just about the middle of our operative field, opposite the first lumbar segment. [Clears away areolofatty tissue until dura is exposed.] . . .

The dura is distinctly edematous. [Incises dura together with subjacent arachnoid: cerebrospinal fluid escapes under tension.] . . . So great is the pressure of the cerebrospinal fluid that it keeps forcing the spinal cord between the incised edges of the dura, just as though the increased pressure were due to ependymal disease. The surface of the cord itself, for an extent of 1½ inches, instead of being pale and white, as it is when healthy, is red from inflammation. The conus is covered with a localized patch of yellow, fibrinopurulent exudate in the center of which is a necrotic phlegmon resembling that of a furuncle (Fig. 45). [Pus escapes—about two drams in all.] . . . That pus represents a central conus metastatic pyogenic infection: it proves that the clinical history is worth all the bacteriologists in the world; I shall have it stained for tubercle bacilli and injected into the veins of a guinea-pig to see if it will induce infection. [It was negative.]

The abscess formed *within* the conus and extended downward for ¾ of an inch below its tip, from which it protruded inclosed by a circumscribed sac. [With gall-bladder spoon removes necrotic plugs of tissue of the carbuncular type.] . . . As a rule, we do not employ drainage in spinal cord cases because it increases the hazard, but in the presence of this pyogenic lesion it is indicated.

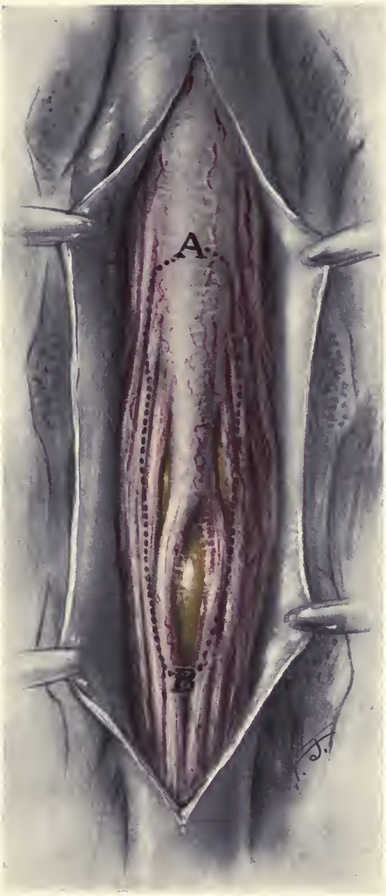

Fig. 45.—Phlegmon of cord: extent shown by black, dotted outline. It extended ¾ inch below tip of conus to point *B*, and upward 2½ inches to point *A*. The phlegmon was cleared away by passing a dull, flexible spoon from *B* to *A*.

[Inserts two rubber drainage-tubes: one, with its end *inside of* the pus-cavity in the conus, was secured to the dural edge with a fine catgut suture; the other, with its end *down to and resting upon* the dura.] . . . It remains to suture the cut edges of the dura accurately up to the foramen occupied by the first drainage-tube, and then just as accurately to approximate the cut edges of the erector spinæ muscle, the vertebral aponeurosis, and the skin on both sides. [Skin finally closed with figure-of-8 sutures, some of silkworm gut, others of horsehair; passage provided for egress of tubes; antiseptic dressing applied.] . . . The head of the patient's bed will be elevated eight inches. The conus ependymal dilatation is the commonest site of this type of non-traumatic metastasis; the brachial plexus bulb of the cord is second in frequency.

POSTOPERATIVE COMMENTS

It does not matter how this case terminates: there is still the great feeling of satisfaction of knowing that, by operating, we gave the patient a chance for her life. Not only do I appreciate Dr. Mix's assistance in establishing the clinical diagnosis, but I am also gratified that he was at hand to see the *living pathology,* which adds so much positiveness to the medical phase: I have frequently expressed the feeling that every surgeon should associate himself with the best internist available and, *per contra,* that every internist should associate himself with the best surgeon available. There should be no specialists in medicine: they should be "universalists," by coöperative team work.

There will be no regeneration of the axons in the center of the conus in this case, because the true cord itself (conus) was involved to a considerable degree, but all the fibers of the cauda which originated from the cord above the point of destruction and were only compressed will rapidly return. The trophic condition shows that many axons are alive. Owing to the relief of the tension, however, the trophic conditions should be better than they were before, and some muscular action should return.

The history of sudden chill, fever, and leukocytosis presented by this patient fits in with all the acute metastatic infections—

whether of the marrow of a bone, a joint, or the spinal marrow. This case teaches the great lesson that we have been inculcating for years *in re* osteomyelitis, namely, that if destruction of the bone is to be prevented, the medulla must be opened into and drained *within the first forty-eight hours* (see vol. v, February, 1916, 173, 174). If, owing to the virulence of the infection not manifesting itself within that period, the time of opening is postponed beyond the first forty-eight hours, when you do open you may at least have been in time to have prevented the maximum degree of obstruction.

Recent experiments—particularly the series that was conducted by Rosenau—have thrown much light upon metastasizing infections of the spinal cord. The spinal cord, which was obtained at necropsy from a patient who had died from the effects of metastatic infection of the cervical zone with paralysis, was ground up and injected into the veins of an animal: later on, when the animal was killed and examined, it was found that the infective material had metastasized to the cervical zone and caused paralysis, thus reproducing in the animal the same lesion from which the patient had suffered. A corresponding result was obtained in a fatal case of brachial plexus zone infection with paralysis.

These experiments demonstrated the affinity which the causative microörganisms seemed to have for certain parts of the body. That this affinity is not governed by accident, but by the inherent peculiarity of the microörganisms, is shown by the newer experiments with various strains of Streptococcus viridans. In these experiments, by a special process of cultivation of the microörganisms in six different media, of six different pathologic lesions which are caused by injectio nof Streptococcus viridans, one can uniformly produce duodenal ulcer by injecting one strain; ulcerative endocarditis from another; toxic myositis from a third; pneumonia from a fourth, etc. Still more interesting was the recovery of the typical Diplococcus lanceolatus from pneumonic processes set up in animals by injecting infective material which was obtained from certain pulmonary cases. It seems probable, therefore, that after having produced one type of disease, when cultivated upon *different* media and then injected, certain microorganisms may produce a different type of disease.

It is to be hoped that this patient's infection has lost its virulence.

Postscript (*January 13, 1916*).—The patient still remains in hospital, having made an uneventful recovery: it is hoped that motion will return in her limbs. No tubercle bacilli were found in the pus obtained from the phlegmon in the conus, nor have guinea-pigs infected with the pus manifested any signs of tuberculosis. The patient is suffering from suppurative cystitis and pyelonephritis from preoperative catheterization: this mode of relief never need be resorted to in women for urinary retention, and is rarely necessary in the male subject.

COMPRESSION FRACTURE-LUXATION OF THORACICOLUMBAR SPINE—DECOMPRESSION

Summary: Clinical history of patient; discussion by Dr. Mix; operation—decompression and removal of a spiculum of bone; postoperative comments—prognosis in this case; rôle of skiagram; when to operate upon injured spinal cords; degeneration *vs.* compression.

CLINICAL HISTORY OF PATIENT

A FEMALE, twenty-four years of age, was admitted to Mercy Hospital December 5, 1915. The family history reveals that an aunt died of pulmonary tuberculosis ten years previously. The past history is negative.

Nearly three years ago, on March 4, 1913, the patient jumped from a burning building, falling 30 feet and landing first upon both feet and then upon the buttocks: the fall resulted in immediate paraplegia and loss of voluntary control of bladder and rectum; the patient was rendered unconscious.

Two months after the accident, on May 4, 1913, a limited amount of power returned to the left foot: one week after this the patient was operated upon for sacral decubitus ulcer. She does not know whether or not the spinal cord was exposed by operation at the same time. There is now a flaccid paralysis of both legs, but not of the thighs.

At present the patient gets about with the aid of crutches, swinging her feet into position.

Examination by Dr. Murphy (June 25, 1915).—The lesion is one that is suggestive of conus-involvement: the patient states that immediately after the injury there was loss of epicritic sensation below the navel, but not of protopathic sensation. The skiagram reveals compression-impaction of the eleventh and twelfth thoracic and the first lumbar vertebræ.

COMMENTS

Dr. Mix will give a report of the neurologic findings.

Dr. Mix: Nearly three years ago, owing to a fire in the hotel in which the patient was employed, it was necessary for her to jump 30 feet to the ground. She landed first upon her feet and then in a sitting posture. Her legs were not broken, but her back evidently bore the brunt of the fall. In addition to these injuries she became unconscious. Such unconsciousness is evidence of injury to the head, because unconsciousness does not take place merely from fracture-luxations of the vertebræ. We have had several instances in this clinic of men injured by diving who remembered perfectly every incident both before and after the accident. In fact, we have never yet encountered a case of loss of consciousness where the spinal cord alone has been affected by fracture-luxations of the vertebræ.

The effect of this fall was sudden and complete paralysis of both legs and of the sphincters of the bladder and rectum. There was also the sudden appearance of anesthesia extending high on the anterior abdominal wall. We have no report of the physical findings at the time of the accident, but the patient is able to tell us something concerning the early course of the case. She remembers that on May 4, 1913,—just two months after the accident,—there was slight motion in the left leg. Gradually power returned in the thighs, so that she was able to innervate both the biceps femoris and the quadriceps extensor muscles, but she has never regained control of the muscles below the knee.

On admission to hospital (December 5, 1915) the ankle- and knee-jerks were absent in both legs. The reflexes of the upper extremity were present and normal. There was double toe-drop, indicating a peripheral or caudal lesion. Below the knee there was flaccid paralysis of the anterior tibial, posterior tibial, and peroneal groups of muscles, which resulted in the aforementioned toe-drop. Atrophy of the calf muscles and the anterior tibial muscles was very evident in both legs. We found fairly good restoration of motion in the quadriceps extensor, the biceps femoris, semimembranosus, and semitendinosus muscles. Below the knee, however, all the muscles were either completely paralyzed or exceedingly paretic.

As to sensation, although she could feel everywhere over her feet, ankles, legs, and thighs, there was, however, a loss of the epicritic sense as high as the territory of supply of the ilio-inguinal and iliohypogastric nerves. In testing the tactile sensation from below upward, the patient states that the sensation which she feels does not become natural until one reaches the groin. Over the anterior surface of the thigh—in the territory of the middle cutaneous branches of the anterior crural nerve from the second, third, and fourth lumbar segments of the cord—there is fairly pronounced loss of the epicritic sense, but preservation of protopathic sensibility.

What do these findings mean? In lesions of the upper motor neurons we find increased knee-jerks, with either a Babinski toe-sign, ankle or patellar clonus, spastic paralysis, and absence of atrophy. In lesions of the lower motor neurons, on the other hand, we find flaccid paralysis, with absent knee-jerks and absence of the special pathologic reflexes, as the Babinski toe-sign, ankle and patellar clonus, and the presence of atrophy. It is evident that this patient's lesion is one of the lower motor neuron type.

Does this mean that she was hurt in the anterior horn cells alone, without an involvement of the pyramidal tracts? This we must answer negatively. It would have been impossible for her to have such a fracture-luxation of the vertebræ as to have caused a lesion affecting the anterior horn cells alone, without affecting the pyramidal tracts. We are forced to conclude that the lesion which took place occurred below the level of the cord, ending in the territory of the cauda equina, presumably somewhere along the tip of the conus. We must assume that the level of involvement is high, because we have found the sensory disturbances extending as high as the territory of the ilioinguinal and iliohypogastric nerves. These nerves, which issue from the lumbar plexus, derive their fibers from the first lumbar segment. Evidently the cauda must have been injured at a point as high as the point of exit of these nerves from the conus, because they are involved.

These sensory findings, therefore, enable us to place the lesion as high as the twelfth thoracic vertebra. We, therefore, have localized this lesion as affecting the conus in the region of the twelfth thoracic and first lumbar vertebræ.

Much recovery of motion has taken place since the original accident. You will remember that at the beginning the patient had complete paraplegia, but as time went on more and more motor power returned to the lower extremities. This was probably due to the absorption of extravasated blood which had compressed the lower part of the conus. As time went on, more and more of the conus was released from pressure by the absorption of blood, until a few months ago, when the improvement ceased. We must assume that at the present time there is still some bone or callus pressure exerted probably not over the whole conus, but only over those central fibers which enter the lowermost portion of the great sciatic nerve. It is because we believe that there is still bone callus or scar pressure upon these fibers that this operation is being performed.

DR. MURPHY (December 8, 1915): The depression which you see at the site of the first lumbar spine suggests a lesion involving the tip of the conus, in accord with the physical diagnosis, as it is a flaccid paralysis.

[Exposure of conus-area as in previous case (see p. 264).] . . . Unlike the preceding case, profuse bleeding follows incision of the soft parts. As we come down upon the fatty areolar tissue in the epidural space there is revealed a spiculum of bone which has been driven from behind forward into the middle of the conus. [Removes spiculum without opening dura.] . . . You can now see the irregularity of the wall of the spinal canal which was demonstrated by the skiagram: this irregularity involves an area of about two inches, so that the conus suffered in conjunction with the caudal filaments. The bleeding has continued profusely, but we take pains to control it before closing the wound, lest a postoperative hematoma, with all its annoyances, should form. [Closes wound as in preceding case (p. 265), but without inserting drainage.] . . .

POSTOPERATIVE COMMENTS

The decompression afforded by resection of the laminæ, together with the removal of the compressing fragment of bone, should relieve this patient, provided the true cord axons are not involved (see vol. v, February, 1916, 51). The skiagram in this case was of much value in that it enacted its true rôle of verifying the location of the lesion as interpreted by an analysis of the physical signs. Given an injury to the spinal cord to deal with, if there is a clean-cut history of instantaneous, complete annular paralysis of both motion and sensation, the chances are that the cord was sectioned at the time of the injury: in such a case operation is futile, for, on account of the reasons given above, the patient would not be benefited. If, on the other hand, the history states that the paralysis appeared *gradually*, or if muscles at different levels (*i. e.*, six or eight inches away from each other) are paralyzed, the chances are that the cord is merely concussed or compressed, and in such a case operation performed by a competent surgeon on the sixth, seventh, or eighth day after the time of the injury offers a favorable opportunity for permanent cure. It may be very difficult before operation to distinguish between degeneration from section of the spinal cord (as well as a peripheral nerve), and suspension of transmission of impulses due to compression or to suspension from traumatic inflammatory reaction. For example, after contusion or compression to the musculospiral nerve the patient presents a typical dropped wrist, just as though the nerve were divided: at operation, however, it is found that the nerve is not divided, but merely compressed; there is a suspension of transmission of impulses, and after removal of the cause of the compression the patient slowly but surely gets well. [In considering the differential diagnosis in this case Dr. Murphy referred to the example of tuberculosis of the thoracic spine with compression of cord by a granuloma (vol. v, February, 1916, 67–77); referred also to use of tuberculin (*ibid.*, 77).]

Postscript (*January 21, 1916*).—Two weeks after the decompression-operation there was a return of the power of voluntary control of the bladder and the rectum. The muscles are regaining their *tonus* rapidly. The patient is still in hospital.

[*N. B.*—For a complete bibliography of previously reported cases of injury or disease of the spinal column or cord see vol. v, February, 1916, 57.]

TRAUMATIC SYNOVITIS OF SHOULDER—STRETCHING OF ADHESIONS BY LORENZ'S METHOD

Summary: **Clinical history of patient; comments—nature of lesion; operation—stretching of adhesions by Lorenz's method; comparison between Lorenz's and Jones's method.**

CLINICAL HISTORY OF PATIENT

A MALE, sixty-six years of age, was admitted to Mercy Hospital September 14, 1915.

Over two months ago, on July 3, 1915, the patient fell off a load of hay eight or ten feet high, striking the right arm upon a corn-cob, or a piece of wood of like size and shape: after the accident he was bereft of the function of the arm, and there was severe pain about its middle, at the site of the trauma; the skin was unbroken. Hot fomentations were applied to the arm—so hot that they scalded the skin: the latter healed without incident, but the pain became worse.

One month ago the pain extended upward to the muscles of the shoulder and downward to those of the arm.

One week ago the patient noticed that the pain was increasing in severity, and that it was worse by night than by day.

At present the arm cannot be abducted—nor even manipulated—without giving rise to pain. The site of trauma has remained discolored ever since the accident.

Skiagram reveals no deviation from the normal conformation of the bones composing the skeleton of the shoulder: palpation suggests thickening of the joint-capsule.

COMMENTS

DR. MURPHY (September 15, 1915): This lesion of the shoulder is of a classic type: it frequently happens that shoulder-traumata which do not result in fracture or luxation eventuate in synovitis with limitation of motion, and the patient will be incapacitated for from thirty to thirty-five months afterward unless treatment be instituted; moreover, if the trauma strikes the arm just below the acromion process of the scapula, subdeltoid bursitis is liable to be an associated lesion (vol. iv, August, 1915, 661–662).

Among the lesions which must be excluded in this case are fracture of humerus; acromioclavicular arthritis; tuberculous arthritis; tenosynovitis of biceps; brachial neuritis; circumflex paralysis (muscular atrophy); axillary abscess; tumors, and periarthritis of shoulder.

Note the limitation of motion when I attempt to abduct the arm to a right angle: beyond that point—from abduction to vertical elevation—the scapula comes into play and rotates because of adhesions in the joint: unless treatment be instituted, the patient will be in this condition for many months more.

When stretching adhesions by manipulation, the patient must be fully under the anesthetic, lest luxation should result from uncontrolled spasmodic contraction of the pectoralis major muscle acting as the fulcrum of a lever, the long arm of which is below the insertion of that muscle into the outer lip of the bicipital groove, while the short arm is the head and neck of the humerus—the head being driven against the weak antero-internal portion of the capsule: now that the patient is fully under the anesthetic, however, I feel confident that such a calamity will be avoided.

The safest method of stretching is that of Lorenz, beginning with gentle manipulations which gradually increase in intensity, always with care until one feels the fibers yield: as I work along I can feel these adhesions yielding all the time. . . . The lower portion of the capsule is now free, and the range of motion has been greatly increased—almost to the normal degree.

The arm will be dressed with an extension-apparatus applied from shoulder to elbow: this will be maintained for four days, until the inflammatory symptoms have subsided. One seldom needs to repeat the treatment if the patient exercises the arm as directed.

Mr. Jones' method of forcible manipulation without an anesthetic is effective, but causes excruciating pain (vol. iv, August, 1915, 662).

DISJUNCTION OF LOWER EPIPHYSIS OF HUMERUS—OPEN REDUCTION—FIXATION BY NAIL

Summary: Clinical history of patient; comments—nature of lesion; operation—reduction of displaced epiphysis by leverage; fixation by nailing; postoperative comments—Gifford's method of artificial leverage in reduction of fractures.

CLINICAL HISTORY OF PATIENT

A MALE, ten years of age, was admitted to Mercy Hospital November 5, 1915.

Two weeks before admission, on October 22, 1915, the patient fell off his bicycle and landed on the left elbow: there was immediate loss of function of the joint. The skin was not lacerated. Skiagram reveals disjunction of the lower epiphysis of the humerus.

COMMENTS

DR. MURPHY (November 9, 1915): Not only does the skiagram reveal disjunction of the epiphysis, but also its displacement to the ulnar side. When the elbow is viewed from the outer side, it presents an almost normal contour: it is only when viewed from the inner side that the deformity becomes a salient feature.

It is now eighteen days since the accident—too late for nonoperative reduction in a young individual. Fractures of the elbow-joint are among the most difficult of surgical lesions to deal with.

OPERATION

[Vertical incision made on radial side of elbow-joint: tissues retracted, exposing bones.] . . . Now you can see the external epicondyle: as I retract, the capitellum comes into the field just internal to it, and the displacement of the epiphysis becomes evident.. Watch me as I free the epiphysis with the lever, using the metaphysis of the humerus as a fulcrum . . . I have succeeded in restoring the epiphysis to its proper relationship with the humerus; and to maintain the reduction I shall insert a single nail through the epiphysis from the external epicondyle. [Fixes epiphysis and closes wound without inserting drainage.]

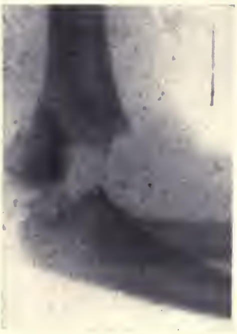

Fig. 46.

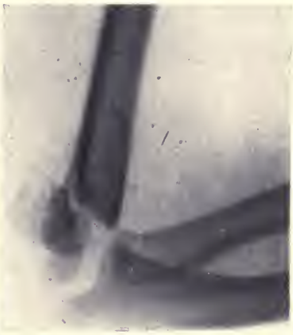

Fig. 47.

Fig. 46.—Fracture at elbow-joint, Case 2 (Gifford).

Fig. 47.—Radiograph one week after injury and reduction; deformity scarcely affected (Gifford).

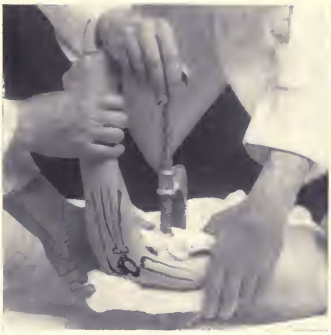

Fig. 48.

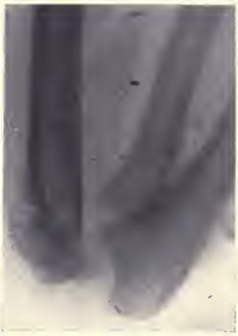

Fig. 49.

Fig. 48.—Shows technic of reducing fracture at the elbow-joint (Gifford).

Fig. 49.—Result of procedure (Gifford).

Postscript.—The patient made an uneventful recovery. At the end of five weeks there was good bony union, and the patient was discharged.

POSTOPERATIVE COMMENTS

In a paper advocating artificial leverage in the reduction of fractures Gifford (*Surg., Gyn., and Obstet.*, February, 1916, 224) writes: "The cases of fracture near the elbow-joint, so commonly seen in children, are, in the writer's experience, almost invariably separations, more or less pure, of the distal epiphysis of the humerus. Some are incomplete; others, complete, are not displaced; others, displaced, especially if seen early, say within an hour or two, are fairly easy to reduce; others may be exceedingly difficult." The following cuts illustrate the method of reduction of Case 2 in Gifford's series.

The reduction can best be effected when the swelling has fully subsided, and the position retained by dressing the forearm at an acute angle with the arm. This should always be done under an anesthetic. If swelling of the hand and forearm or if much pain follow the reduction-dressing, the bandages and the supports must be released at once, as the myositis, which is so detrimental in these cases, may follow and Volkmann's contracture result.

RECENT COMMINUTED FRACTURE OF HEAD OF RADIUS—REMOVAL OF HEAD—ARTHROPLASTY

Summary: Clinical history of patient; comments—correlation of clinical signs with skiagraphic findings; mechanism of injury; outline of plan of treatment; operation—removal of fragments; arthroplasty; postoperative comments—early aseptic operation gives best result; the question of passive motion.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-three years of age, was admitted to Mercy Hospital June 29, 1915.

Three days previous to admission, on June 26, 1915, while riding horseback, the girth-strap gave way, and the patient tried to dismount on the right side, with the right foot still in the stirrup: the loosened saddle came off the horse with his foot, however, and the patient fell to the ground, landing upon the right elbow.

A physician, suspecting fracture, put the elbow at rest upon a pillow for the night: no attempt at reduction was made, nor was a splint applied. At present there is practically no pain.

Examination by Dr. Murphy (June 29, 1915).—While the patient is able to extend the elbow, yet flexion is blocked and painful: the range of extension is unimpaired. The head of the radius is fractured and displaced.

COMMENTS

DR. MURPHY (June 30, 1915): According to the history, the patient was unable to flex the elbow, and forced flexion caused great pain: this circumstance signifies a flexion-block in the joint, and reference to the skiagram reveals a stellate fracture of the head of the radius (Fig. 50), with displacement of fragments forward between the coronoid process and the coronoid fossa—thus accounting for the block during flexion.

The injury was caused by direct violence, the patient landing upon the head of the radius, compressing it between the ground and the lesser sigmoid fossa of the ulna: first the head was split, then expressed into the position of displacement, like a small boy pops out a fruit-stone from between his thumb and finger. When the head of the radius is split in this manner, it may be displaced as far as 1¼ inches from the elbow-joint: in such a case there is no block to flexion; it is only when the displaced fragment remains near the joint that motion is limited. The neck of the radius is retained *in situ* by the untorn orbicular ligament.

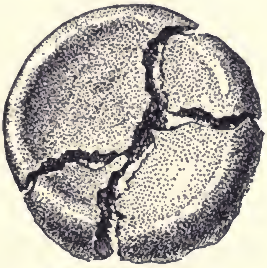

Fig. 50.

This injury must be treated by open operation because the displaced fragments cannot be reduced by conservative manipulation: after exposure we shall endeavor to reduce the fragments and nail them in place; failing that, the fragments of the head must be ablated. In any event the operation must be performed without hand-contacting of the wound—particularly since it is but four days from the time of receipt of the injury, and the tissues have not had an opportunity of protecting themselves against infection by the process of coffer-damming.

OPERATION

[Vertical incision made beginning at external epicondyle and passing downward over neck of radius: tissues retracted exposing site of fracture.] . . . Now you can see a hematoma which formed at the site of fracture: we must evacuate it. There is one fragment, pushed up into the coronoid fossa: it is the fragment which blocked flexion. There are the three other fragments into which the remainder of the head was split. [Removes all four fragments.] . . . I shall cover the stump of the neck of the radius with an interposing flap obtained from the outer portion of the capsule of the elbow-joint, dissecting it free from the outer surface of the synovial membrane. [Interposes capsular flap in new radiohumeral joint and closes wound without inserting drainage.] . . .

POSTOPERATIVE COMMENTS

The forearm will be dressed at a right angle and immobilized for from three and one-half to four weeks until all the structures are healed.

We never operate upon these fracture-cases on the first day of the injury: to get the best result, however, operation should be performed within four or six days after the time of the accident —never as a late operation.

Ligatures are rarely necessary in this work, and hand-contacting of the operative field must be avoided: notwithstanding the fact that we entered the cavity of the elbow-joint, yet by observing such strict aseptic precautions, the patient is in little or no danger of infection and should get a good result. The forearm can now already be flexed and extended without any difficulty.

Formerly, when dealing with a fracture near a joint, passive motion was begun early as a routine measure: that, however, was a mistake, for the trauma consequent upon the passive motion caused recurrent hemorrhage, with subsequent organization of the blood-clot and osteogenesis in it, the resulting large amount of callus producing great limitation of motion in the joint. Far better is the plan of immobilizing the joint in the most favorable position for subsequent use until all the tissues have healed, whereupon the joint may be put through slowly increasing degrees of passive motion, but never to the extent of causing severe pain, which means laceration of tissues, with its attendant undesirable sequelæ.

Postscript.—There was primary union and a good range of motion was rapidly acquired. The ablation of the radial head does not seem to have impaired the strength or usefulness of the forearm.

RECENT FRACTURE OF OLECRANON PROCESS OF ULNA—REDUCTION AND EXTRA-ARTICULAR NAILING

Summary: **Clinical history of patient; comments—importance of taking skiagrams in more planes than one; results by conservative measures in fractures of olecranon and of patella; two plans of operative fixation; operation—reduction and extra-articular nailing.**

CLINICAL HISTORY OF PATIENT

A FEMALE, thirty-seven years of age, was admitted to Mercy Hospital November 23, 1915.

Four days previously, on November 19, 1915, the patient, while stepping from a trolley-car, slipped and fell to the street, landing upon the hip and elbow of the right side: not being unconscious, she was assisted to her feet, and then noticed for the first time pain in the elbow.

One hour after the accident a dressing was applied to immobilize the forearm in the position of extension. The hip is painful when pressed upon, but the patient experiences no difficulty in walking.

The right arm exhibits ecchymosis from the shoulder down. A skiagram was taken the day before admission and revealed a fracture of the olecranon process of the ulna.

COMMENTS

DR. MURPHY (November 24, 1915): In the anteroposterior view, with the forearm extended, the skiagram suggests a fracture of the internal condyle of the humerus: the condyle is blurred and irregular, and a diagnosis cannot be established from this picture. The lateral view, however, of the *flexed* forearm clearly reveals a fracture of the olecranon process of the ulna, with wide separation of the fragments (Fig. 51, *1*). Here, again, is an illustration of the importance of having skiagrams taken in more planes than one.

When the olecranon process has been fractured, a very serviceable result may be obtained by conservative measures—even though there was considerable separation without bony union. The same serviceable result is obtained at times in cases of fracture of the patella: thus I recall a case of fracture of the patella with fibrous union in which the fragments had separated from each other until the fibrous bond had been spun out to a length of seven inches. In many of my cases of excision of the patella for tuberculosis in which a substitute for the patella is fashioned by splitting the quadriceps tendon and overlapping it, the patients were subsequently enabled to walk without limping, and thus with a very serviceable limb (vol. i, June, 1912, 326).

There are two plans of fixation for fracture of the olecranon process—subcutaneous wiring (*Jour. Amer. Med. Assoc.*, January 27, 1905) and subcutaneous nailing: we shall employ the latter in this case.

OPERATION

[Site of fracture exposed by incision between olecranon-tip and triceps tendon.] . . . Now you can see the rough end of the distal fragment: owing to the early stage of the fracture (four days) I find it easy to appose the proximal to the distal fragment. I shall maintain the apposition by driving a long finishing nail through the proximal into the distal fragment (Fig. 51, *2*) by the extra-articular method (see vol. iv, December, 1915, 1109) and without hand-contacting of the wound, nor compounding the fracture. We may remove the nail subsequently. [Closes incision.] . . .

Postscript (*January 4, 1916*).—It is now six weeks since the operation was performed: firm callus has formed, and the soft tissues have healed *per primam*. The nail was extracted today without the slightest difficulty.

January 21, 1916.—Examination of the elbow reveals a very satisfactory range of motion. The patient has been instructed how to increase the range of motion day by day until she can place the hand upon the shoulder of the same side.

[Cases of fracture of the olecranon process have been previously reported as follows: vol. i, June, 1912, 325–337—Subcutaneous Wiring; vol. iii, June, 1914, 523–530—Resulting Bony Ankylosis Overcome by Arthroplasty; vol. iv, October, 1915, 863–868—Resection of Olecranon; vol. iv, December, 1915, 1095–1108—Resulting in Cicatricial Fixation of Ulnar Nerve.]

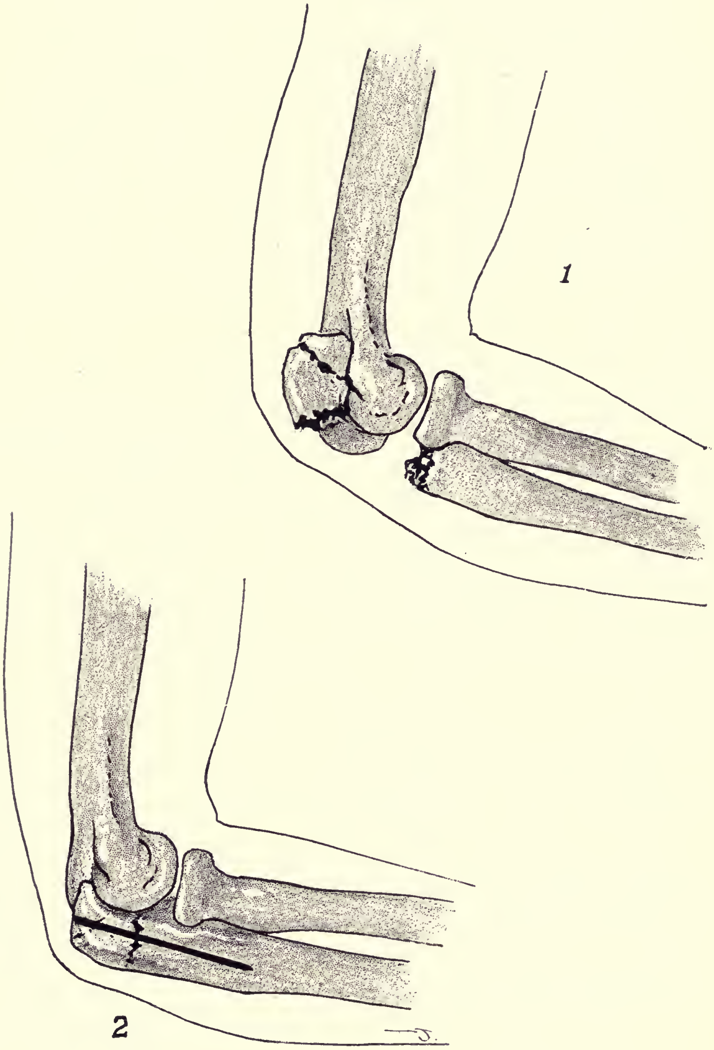

Fig. 51.

MUSCULOSPIRAL PARALYSIS DUE TO ANCIENT COMPOUND FRACTURE OF HUMERUS—TENDON-TRANSFERENCE (FLEXOR CARPI RADIALIS TO EXTENSORS OF DIGITS)

Summary: Clinical history of patient; comments—cause of wrist-drop; cure of wrist-drop—neurorrhaphy futile in an infected field; outline of tendon-transference operation; operation—transference of tendon of flexor carpi radialis to extensors of digits; removal of Lane plate; postoperative comments—explanation of compression of nerve; indications for the tendon operation: its results; injuries to the musculospiral nerve in modern warfare.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-nine years of age, was admitted to Mercy Hospital September 28, 1915.

Seven months previously, in February, 1915, the patient suffered a compound fracture of the left humerus by being struck by a large rock upon the outer aspect, near the middle of the shaft of the bone; the latter was driven through the skin on the inner aspect of the arm. The arm was immobilized in a splint: by the end of two months the soft tissues had completely healed, but the bone-fragments were ununited.

Two months after the accident, in April, 1915, the arm was operated upon: a Lane plate with eight holes was screwed to the ends of the fragments; the soft tissues healed within twelve days. The patient noticed the wrist-drop for the first time after the operation.

Two months after the operation, in July, 1915, a sinus appeared on the arm over the site of the Lane plate: the latter was not removed.

At present there is total paralysis of the musculospiral nerve below the site of fracture.

COMMENTS

DR. MURPHY (September 29, 1915): To all appearances there is bony union of the fragments, but as a sequence of the operation there is wrist-drop, indicating that the musculospiral nerve was either severed during the operation or compressed by the screwing home of the Lane plate.

Two months after the operation a sinus opened up on the surface of the arm, began to discharge, and continued discharging: we must, therefore, remove the plate.

The next problem is, How shall we overcome the wrist-drop? Owing to the suppuration about the plate the musculospiral nerve at the site of fracture is in an infected field: to isolate and join its ends by neurorrhaphy in such a field would in all probability result in breaking down of the line of union from infection; the fibrous tissue left remaining between the ends of the nerve after the subsidence of the infection would effectually block the advance of the growing proximal axons toward the distal axons. Neurorrhaphy, therefore, is out of the question. It is, of course, possible to render the hand more useful by placing it in the neutral position as regards flexion and extension, and securing it by performing arthrodesis of the wrist-joint, or by grafting a bone-splint to the radius above the joint and the carpus below; but regaining the power of extending the fingers is of considerable importance to the patient. It is for just such a case that we devised the method of tendon-transference, by means of which the tendon of the flexor carpi radialis is made to do the work of the paralyzed extensors of the fingers.

In this operation of tendon-transference for the correction of wrist-drop a flexor tendon is selected which is long and strong, and yet which is not indispensable to the flexor mechanism of the wrist or fingers, and which is not too remote from the tendons that are to be reënforced: such a tendon is that of the flexor carpi radialis muscle, which inserts into the palmar aspect of the base of the second metacarpal bone and sends a slip to the base of the third metacarpal—thus being *vis-à-vis* to the tendons of the extensores carpi radialis longus et brevis; flexion of the wrist is not crippled by the transfer of this tendon, because the tendon of the flexor carpi ulnaris and that of the palmaris longus, and secondarily those of the fingers, assume the function of the absent member.

The tendon is released by severing it at the lower border of the anterior annular ligament; it is withdrawn five inches higher up, through a short vertical incision made over the course of the muscle (vol. iv, August, 1915, Fig. 183 *et seq.*, pp. 683–687); through a vertical incision made over the dorsum of the wrist forceps are passed subcutaneously up to the higher incision, grasp the end of the tendon, and bring it down beneath the skin and over the brachioradialis to the site exposed by the lower dorsal incision where the extensor tendons begin to spread out on their way to the fingers. The transferred tendon is now made to pass through perforations in the digital tendons which are successively encountered from the radial to the ulnar side of the wrist, and at such an angle as will permit extension of the digits in the same order of succession, and of the thumb and index independently of the remaining three digits. There will thus be encountered in order the tendons of the extensor pollicis brevis, extensor pollicis longus, the two tendons of the index, that of the middle, that of the ring, and the two tendons of the least finger: between the first tendon and that of the middle finger the transferred tendon passes obliquely from above downward and inward (thus extending first the thumb and then the index independently of the remaining digits), and between the tendons of the index and middle fingers the transferred tendon changes its direction and passes obliquely from below upward and inward through the tendons of the middle, ring, and least fingers (thus extending the remaining digits after the thumb and index have been extended). It is now understood why the inner three tendons cannot be extended until after the outer two have been extended. The perforated extensor tendons are tacked to the perforating transferred tendon by means of chromicized catgut sutures. The edges of the fat-bearing superficial fascia are carefully united over the field of tenoplasty to prevent adherence of the tendons to the skin: after closure of the latter the hand is dressed in the position of superlative extension until union is firm: removal of the splint for inspection as early as the third or fourth day will reveal the beginning functioning of the transposed flexor (now extensor) tendon.

It can be seen what a time-saver this operation is for the patient: complete restoration of function may be expected within from four to six weeks, while after nerve-approximation twelve months must elapse before function is restored. The results of this operation have been gratifying, and the work is not difficult technically, but just a little tedious, from the necessity of minute attention to details.

OPERATION

[Dr. Murphy's operation of tenoplasty for the relief of musculospiral paralysis was performed as outlined above: the perforations in the extensor tendons for the passage of the perforating transposed flexor tendon were made with the fingers in the position of superlative extension, so as to prevent any lost motion (*cf.* Fig. 35, p. 198).] The importance of the no-hand contacting technic in this work cannot be emphasized too strongly, and it is needless for me to say that an infection involving these tendon-sheaths would be disastrous.

[Lane plate on humerus exposed and found surrounded by pus; two screws found loosened; eight screws and two wires removed; wound in arm closed with provision for drainage.] . . .

POSTOPERATIVE COMMENTS

The enormous length of this plate (eight screws) probably accounts for the inclusion of the musculospiral nerve beneath it: the original skiagram revealed a long fragment separated from the humerus, but still attached to the periosteum, and I presume that this explains why the surgeon inserted such a long plate and secured it with wires in addition to the eight screws.

There is non-union of the fragments: this cannot be dealt with until the infection clears up, and then we shall insert an autogenous bone-graft splint.

In cases in which, for one or another reason, direct suture of the severed ends of the musculospiral nerve is not feasible, this operation of tendon-transference admirably fulfils the indication of restoring the power of extending primarily the digits and secondarily the wrist: to date we have had 100 per cent. successes, but, of course, do not know whether the operation will continue to work out so favorably. It does not take the patient long to learn to coördinate the function of the transposed flexor tendon properly and adapt it to his needs: one patient, a professional masseur employed in the Battle Creek Sanitarium, reëducated his fingers with surprising rapidity; of course, where very nimble use of the fingers is required,—as in the case of a professional musician,—the operation is not so promising. When the question of restoring the more delicate and intricate movements of the fingers is paramount, it is advisable to employ the longer and slower method of neurorrhaphy: this may require several months if one must develop an aseptic field before the nerve-ends can be united with safety, in addition to the time required for the slow and patience-exhausting restoration of motion after neurorrhaphy.

The musculospiral nerve is especially vulnerable in modern warfare, owing to the exposed position of the left arm in rifle-firing. The following table, extracted from the "*Report on the Surgical Cases Noted in the South African War, 1899–1902*" (London, 1905, 266), shows the comparative frequency of injuries of the various nerve-trunks (62 nerve-injuries in 58 men).

Nerve Injured	Number of Injuries	Rates Per Cent.
Musculospiral	16	25.8
Ulnar	12	19.3
Median	9	14.5
Sciatic	7	11.2
Brachial plexus	7	11.2
External popliteal	4	6.4
Internal popliteal	1	1.6
Long saphenous	1	1.6
Musculocutaneous of arm	1	1.6
Cervical plexus	1	1.6
Anterior crural	1	1.6
Short saphenous	1	1.6
Radial	1	1.6
In 58 cases	62	..

To this table there is added a note stating that the higher comparative frequency of injury to the musculospiral nerve is due to its close relation to the bone and its consequent liability to implication in fracture cases. In the "*Medical and Surgical*

History of the War of the Rebellion" (Part Second, 464) there are reported, however, five cases of gunshot flesh wounds involving the musculospiral nerve, in none of which was the humerus fractured. There will doubtless be a large number of cases resulting from the present war in which this operation of tenoplasty for musculospiral paralysis will be applicable.

(For further information concerning this operation consult vol. iii, June, 1914, 472; vol. iv, August, 1915, 677–679.)

TUBERCULOUS TENOSYNOVITIS OF PALMAR SYNOVIAL BURSA—INJECTION OF CALOT'S SOLUTION

Summary: Clinical history of patient; comments—recognition of nature of malady; pathogenesis and pathology of the lesion; Virchow's description; treatment—injection of Calot's solution.

CLINICAL HISTORY OF PATIENT

A FEMALE, forty years of age, was admitted to Mercy Hospital November 22, 1915. The family history reveals that the patient's maternal grandparents died of pulmonary tuberculosis, and that her father died of probable cancer of the stomach. The past history is negative.

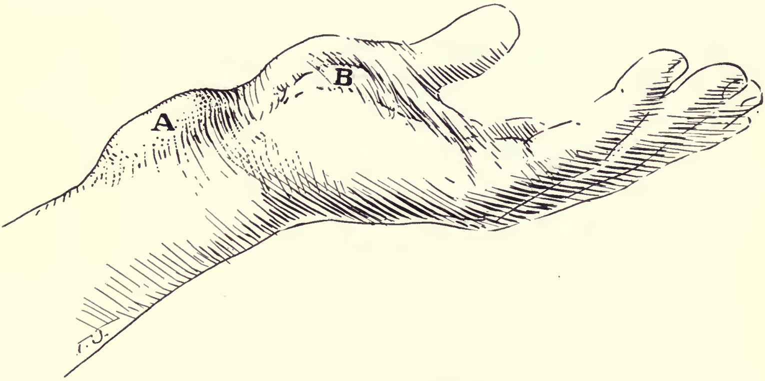

Fig. 52.—The great palmar synovial bursa appears as though injected with wax for an anatomic preparation. Seen from the volar aspect, the characteristic hour-glass shape would be manifest. (See Fig. 53.)

Two years ago, in 1913, the patient noticed for the first time numbness in the palm of the left hand, and before long a soft, boggy, and painful swelling appeared, involving both the palm (Fig. 52, *B*) and the volar surface of the wrist, just above the anterior annular ligament (Fig. 52, *A*). About five months later the tumor was operated upon and a "peculiar growth" found and ablated: an enlarged epitrochlear lymph-node also was removed. After the operation the swelling did not entirely subside.

Five months after the first operation, in September, 1914, a second operation was performed: this time the appendix was removed, and the operating surgeon stated that there were evidences of tuberculous peritonitis.

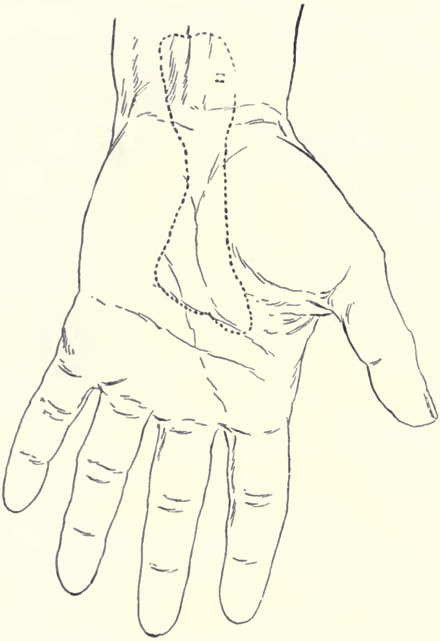

Fig. 53.—Tuberculous tenosynovitis of palmar bursa. Diagrammatic sketch of distended bursa (P. G. Skillern, Jr.). (From Int. Clinics, vol. iv, twenty-third series, 1913.)

Four months after the second operation, in January, 1915, the third was performed: this time the tumor at the wrist was resected and an enlarged axillary lymph-node removed. After the operation the former did not entirely subside, but later began to enlarge by degrees until it reached its present size.

During the past two years there have also been a burning pain and an occasional swelling at the fibular side of the left ankle-joint.

Examination by Dr. Murphy (November 22, 1915).—The left palmar synovial bursa is the site of tuberculous tenosynovitis: a similar condition involves the left ankle-joint. The epitrochlear and other lymph-nodes in the left arm are enlarged.

COMMENTS

Dr. Murphy (November 24, 1915): This is a very peculiar, although characteristic, lesion, and one that would puzzle those who are not alive to the situation. The continuity of the swelling in the palm with that above the wrist may be determined by alternating or "see-saw" palpation: were it not for the constricting anterior annular ligament there would be but one huge swelling. By the same method of physical examination the rice-bodies may be felt crowding back and forth from one loculus to the other:

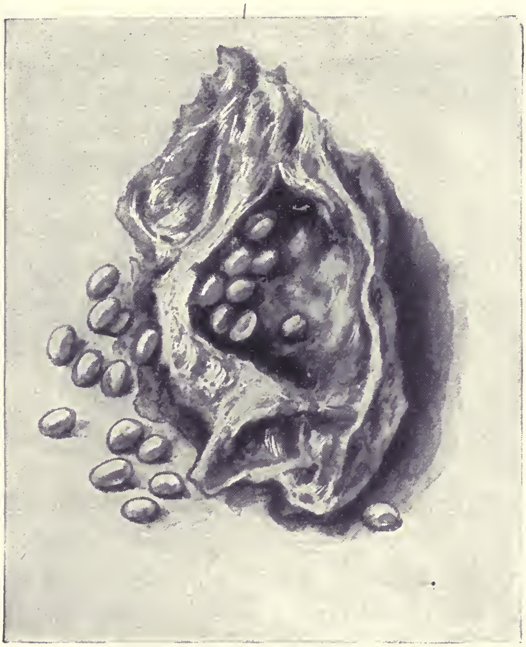

Fig. 54.—Fungous type of tuberculous tenosynovitis. Opened to show oryzoid (rice) bodies, which are fibrin-derivatives (P. G. Skillern, Jr.). (From Int. Clinics, vol. iv, twenty-third series, 1913.)

these rice-bodies (Fig. 54) are dead proliferations of partially developed fibrin-tissue from the small synovial villi or *Zotten.* They contain small numbers of tubercle bacilli.

This is the "compound" ganglion of our forefathers. The primary source of the tubercle bacilli is problematic: however, there arose a metastatic hematogenous invasion of the palmar bursa, which is easily rendered a *locus minoris resistentiæ* by the constant trauma to which the palm of the hand is exposed, but from which it is protected in some measure by the dense and unyielding palmar fascia. Once the tuberculous process has lodged in the palmar synovial bursa, the chances of spontaneous healing are reduced to a minimum, owing to the constant to-and-fro movements of the flexor tendons, whose range of motion at the annular ligament averages one centimeter. (See Figs. 36, 37, pp. 199, 200.)

On section of the tuberculous sheath three layers are demonstrable. The outer layer is formed of fibrous tissue, more or less inflamed; the middle, of granulation tissue, studded with tuberculous nodules (this layer is the active seat of the disease); the inner layer, of a deposit of fibrin varying in thickness. When the granulation tissue is present in great abundance, it may fill up and distend the tendon-sheath, causing a marked doughy swelling, as in this patient.

In his own words, Virchow ("Die krankhaften Geschwülste," Berlin, 1863, vol. i, 207) describes this lesion as follows:

"In the case of *hygroma proliferum* of the sheaths of the flexors of the fingers there arises on the volar side of the hand, as a rule, a bilocular, hour-glass-shaped swelling, of which one-half lies in the forearm and the other in the palm of the hand, so that both communicate with each other beneath the volar carpal ligament. Should one press upon one side, the little bodies run through the narrow opening back into the other side, and one can simultaneously push the swelling as a whole to and fro. Thereupon the bodies give rise to a peculiar, crepitating sensation, like a bag of shot when pressed alternately between the fingers. As to their form, the bodies are designated as pear-shaped, or shaped like a grain of rice: *corpuscula pyriformia oryzoidea.*"

TREATMENT

I am injecting the involved palmar synovial bursa with Calot's solution, which consists of 2 parts each of creosote and guaiacol, 10 parts of iodoform, and 100 parts of olive oil (for dosage, etc., see vol. v, February, 1916, 106). This is the best curative injection which has yet been formulated for tuberculous lesions. . . . I am now massaging the bursa so as to distribute the injected fluid throughout its recesses. I shall inject the ankle lesion in a similar manner.

Postscript (January 23, 1916).—Two additional injections of the palmar synovial bursa have been made since the time of the operation, and the swelling has practically disappeared. The patient is still in hospital.

[A case with the following title was published in vol. iv, June, 1915, 497–503: "Chronic Tendovaginitis of the Extensor Tendon of the Thumb.—Excision of the Tendon-sheath with the Underlying Periosteum.—New Tendon-sheath Made from Pedicled Flaps of Fat." Sketches of operative steps on p. 502.]

ANCIENT FRACTURE-LUXATION OF METACARPOPHALANGEAL JOINT OF FINGER—RECTANGULAR RESECTION OF METACARPAL CALLUS WITH RESTORATION OF HEAD TO POSITION—ARTHROPLASTY

Summary: Clinical history of patient; comments—restoration of function of fingers of vital importance to wage-earners; description of deformity; operation—resection of metacarpal head; arthroplasty.

CLINICAL HISTORY OF PATIENT

A MALE, fifty-seven years of age, was admitted to Mercy Hospital December 9, 1915.

Nearly three years ago, in January, 1913, the patient fell into a pit, and in throwing forth the right hand to break the fall, injured the metacarpophalangeal joint of the right middle finger: after the injury the joint remained painful and swollen, and the patient has not had much use of it since.

Ten months after the injury a splint was applied to the digit and retained for one month: this relieved much of the soreness.

During the past eleven months the patient has been unable to work on account of painful functioning of the hand and limitation of motion in the joint involved.

Examination by Dr. Murphy (November 24, 1915).—The base of the proximal phalanx of the right middle finger is luxated toward the volar surface and the head of the metacarpal—a portion of which is split off—is luxated toward the palmar surface: this deformity accounts for both the pain and the loss of function of the joint.

COMMENTS

DR. MURPHY (December 11, 1915): This lesion is seemingly a trifling matter, but the patient, an engineer, is unable to work because of it: pain arises every time he pulls a lever. It is these seemingly trifling lesions that make up the bulk of every-day practical surgery, and the importance to wage-earners of their proper treatment may be reckoned in the terms of large sums of money lost as wages. The metacarpal head is luxated toward the volar surface and abolishes the power of flexion, as it blocks the phalanx in flexion.

OPERATION

[Lateral incision between heads of right index and middle fingers: retraction of tendons; exposure of joint.] . . . The deformed metacarpal head is now exposed in the field. We shall resect a rectangular wedge, but preserve the flexor articular surface, swinging it backward and then upward until it articulates with the base of the proximal phalanx (Fig. 55). . . . Our scheme has worked out beautifully. The resected metacarpal head is now steadied by suturing the capsule, and finally we shall introduce a subdermal stitch in such a manner as to invert the fat between the bone-ends (arthroplasty). . . . [Dressing applied and finger splinted.]

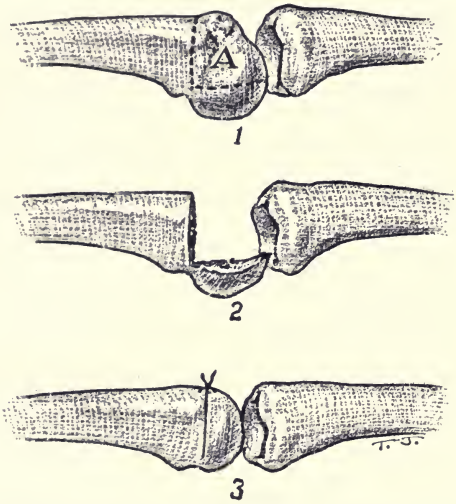

Fig. 55.—1, Lines for resection of rectangular wedge *A* from deformed head of metacarpal. 2, Cartilage-covered flexor surface of head preserved, rotated on hinge, and contacted with sawn base of head, and secured by one catgut periosteal suture (3).

Postscript (*January 24, 1916*).—The wound healed *per primam.* The result was full restoration of function in nine weeks.

POST-APOPLECTIC HEMIPLEGIC CONTRACTURES—TENOTOMY OF HAMSTRINGS AND OF TENDO ACHILLIS

Summary: Clinical history of patient; comments—etiology of apoplexy; characteristics of cerebral *vs.* spinal paralysis; outline of operative procedure; operation—tenotomy of hamstrings, stretching of posterior capsule, tenotomy with elongation of tendo Achillis; postoperative comments—importance of prophylactic and of early treatment of contractures.

CLINICAL HISTORY OF PATIENT

A MALE, fifty-five years of age, was admitted to Mercy Hospital January 28, 1916. The family history reveals that two uncles—one paternal and one maternal—died of paralysis.

Ten years previously the patient was stricken with paralysis one night while in bed: the stroke assumed the form of right-sided hemiplegia; the patient remained unconscious for ten weeks; when he recovered his senses, he found that he was able to move the leg, although it dragged when he hobbled about the room.

Three years after the stroke occurred considerable motion was present in the leg, but the knee was fixed in the position of flexion. The arm has remained paralyzed: while the patient is able weakly to flex the fingers, yet he cannot extend them. Sensation is unimpaired. The blood-pressure registers 145.

Examination by Dr. Murphy (January 10, 1916).—The hamstrings are contractured: a weak tendon-reflex may be elicited. Ankle-clonus is present.

COMMENTS

DR. MURPHY (February 2, 1916): The comparatively early age—forty-five years—at which the stroke occurred in this case is strongly suggestive of a spirochetic basis, although the patient denies such an infection, and no positive von Wassermann reaction was obtained. He seems older than his fifty-five years from his having been a paralytic for ten years, from the sclerotic condition of his vascular system, and probably from the assumed ancient spirochetic infection.

When apoplexy occurs later in life,—at the age of fifty-five years, for example,—the etiologic factor of the underlying arteriosclerosis is usually non-luetic, but may be either a primary focus of pyogenic infection or a nervous stigma which results in high vascular tension. The primary pyogenic focus may be lodged in the respiratory system (nose and accessory sinuses, including the middle ear); the digestive system (mouth, alveolar process, oropharynx, biliary tract, appendix, colon); the genito-urinary system (urethra, prostate gland, seminal vesicles, uterus or adnexæ); or the osseous system. With few exceptions all tissues of the body are supplied with blood-vessels: hence arteriosclerosis means fibrotic degeneration in all tissues—especially those of the great internal organs, as the kidneys (chronic interstitial nephritis or Bright's disease), the heart (chronic endocarditis), and aorta (atheromatous plaques), the lungs (fibroid phthisis), etc. The infection is usually of an attenuated type, which acts slowly and insidiously, and is not necessarily pyogenic. The effects upon the vascular apparatus of non-bacterial toxins—whether metabolic or alcoholic—must also be considered.

The spastic paralysis with which this patient is afflicted is characteristic of lesions involving the upper (cerebral) motor neurons, and the contracture of the flexor group of muscles is characteristic of spastic paralysis: with the antagonizing groups of muscles both in a state of tonic contraction, the stronger flexors always predominate over the weaker extensors. The preservation of the tendon-reflexes and of muscular contractile power is also characteristic of lesions involving the upper motor neurons, for the presiding spinal cell-bodies of both the reflex and the trophic fibers are intact, but, owing to the cerebral lesion, the patient has no voluntary control over the spinal centers: when, on the other hand, the lesion involves the spinal cord, flaccid paralysis with loss of tendon reflexes and trophic impulses results—a condition that is exemplified by anterior poliomyelitis.

The chief source of the patient's difficulty is the flexion-contracture of the knee, which renders walking impossible: this contracture may be overcome by tenotomizing the hamstrings, extending the knee, and, when the tissues have healed, ordering for the patient a leather brace as a support to the knee when walking; if tenotomy should not relieve the contracture, it will be necessary to resect the joint.

The hamstring flexors comprise one muscle externally—the biceps; and three internally—the semimembranosus, semitendinosus, and gracilis.* By virtue of its low insertion (head of the fibula) the biceps flexor cruris—which is also an external rotator—acquires an enormous leverage upon the leg, and when contractured, is responsible for most of the pressure in the knee-joint. In infantile palsy, where the quadriceps extensor is involved, the strong biceps may be transferred so as to reënforce the quadriceps (see vol. iv, October, 1915, Figs. 248, 249, 250, pp. 986–987): the result is admirable, but the operation should not be attempted before the expiration of the usual three-year period, during which progressive improvement occurs.

Not only must the hamstrings be divided, but the contractured posterior portion of the knee-joint capsule must be stretched, and the tendo Achillis must be severed subcutaneously and elongated so as to release the knee-joint from the flexion-power of the gastrocnemius muscle. Were the patient younger, arthrodesis would be performed, according to the method first practised by Albert, of Vienna, in 1878, for the production of a stiff knee instead of a flail joint when retention by external apparatus is undesirable.

OPERATION

[Constrictor applied to upper portion of thigh: in lower portion a vertical incision was made externally so as to expose biceps; tissues retracted.] . . . You can see the biceps tendon well exposed in the field: in severing it care must be taken to avoid injuring the external popliteal nerve, which lies internally under shelter of the tendon. In order to insure retraction of the tendon to the utmost degree I shall also separate the short head of the biceps from its origin from the outer lip of the linea aspera and upper two-thirds of the external supracondylar ridge of the femur (Fig. 56). . . .

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* According to Cunningham, that part of the adductor magnus which arises from the ischium and inserts into the adductor tubercle should, upon morphologic grounds, be included in the internal hamstring group, seeing that it, too, is supplied by the branches of the great sciatic nerve which are apportioned to the hamstrings proper.

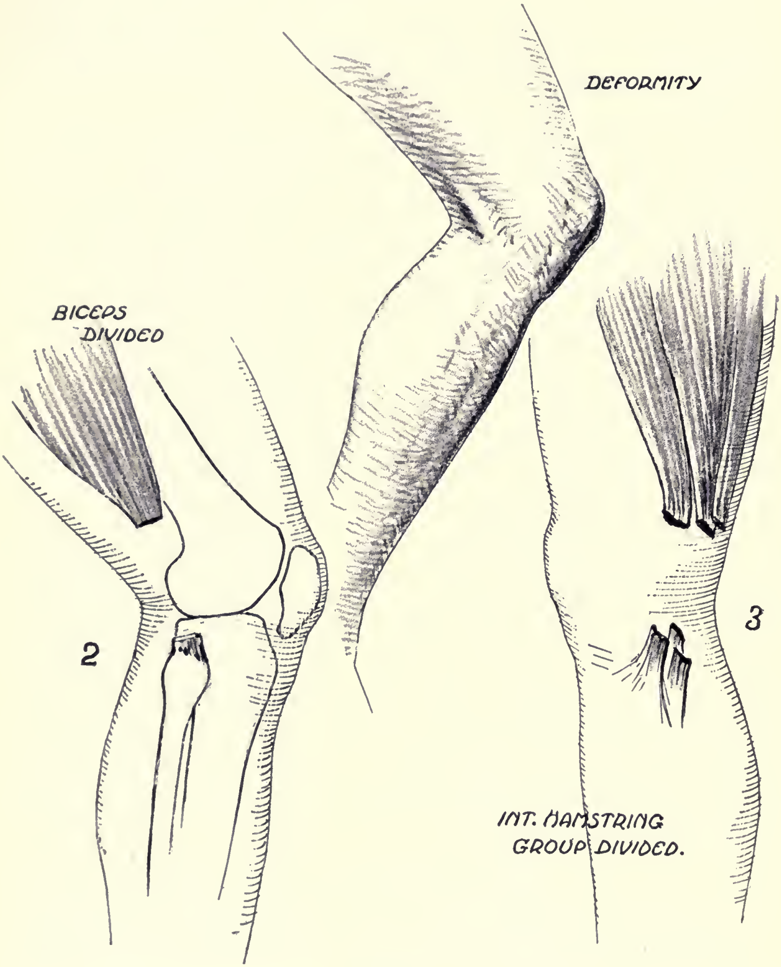

Fig. 56.

In approaching the inner hamstrings in patients in whom the knee-joint functions it is important to avoid placing the incision in the popliteal space, lest a contracture should arise from the resulting scar-tissue (vol. iv, October, 1915, 808): in the present case, however, motion is not a desideratum, so that an exception might be made to the rule here. [Vertical incision made along posterior portion of internal condyle, avoiding long saphenous vein; tissues retracted, exposing tendon of semitendinosus.] . . . In dealing with the inner hamstrings one works in a zone of comparative safety as regards vessels and nerves. [Severs tendons of semitendinosus and gracilis: they retract.] . . . You can now see the underlying tendon of the stout semimembranosus on its way to its insertion into the back of the internal tuberosity of the tibia and posterior portion of the capsule of the knee-joint. [Severs tendon of semimembranosus: it retracts; sutures both wounds and removes constrictor.] . . . The knee can now be extended very satisfactorily (Fig. 56, *3*): the sartorius, as a rule, is not sufficiently contractured to require division. [Performs tenotomy of tendo Achillis (*vide infra*, p. 335).]

After severance of the tendons it was necessary to stretch the posterior portion of the capsule before complete extension could be attained. The knee will be kept in the position of semiflexion, however, until it has accommodated itself to the altered tension: it will then be straightened, and an extension-apparatus with a traction-weight of ten pounds will be applied. After the soft parts have healed a leather brace will be adjusted to the knee so as to enable the patient to walk about.

After severance of the tendons we saw to it that their ends retracted well up the thigh, to lessen the liability of their reunion and recurrence of the flexion-contracture. In the future, owing to the division of the hamstrings, the tendency will be toward much freer action of the extensor muscles, which are still fully controlled by the motor nerves.

There is no reason why this patient should not have been walking around much of the time since the onset of the paralysis; had the knee been immobilized by plaster-of-Paris, or supported by a leather brace in the first instance, the flexion-contracture for which we operated today would have been prevented.

In these cases of cerebral hemiplegia the subsequent usefulness of the limb is enhanced when the tendons are divided early in the course of the contracture: if not completely divided and allowed to retract, as in this case, they may be elongated by our Z-shaped method, which is employed most frequently for division and elongation of the tendo Achillis. The same remarks and the pursuance of the same principles apply to the upper extremity as well; *e. g.*, the contracture of the biceps flexor cubiti and that of the flexors of the hand and wrist may be overcome by division with either retraction or elongation.

Postscript.—The limb was effectually straightened out: there was considerable pain in the joint, which slowly disappeared. Healing occurred *per primam.*

I. CHRONIC FOCAL OSTEOMYELITIS OF TIBIA (BRODIE'S ABSCESS)—EVACUATION; CONTRACTURE OF TENDO ACHILLIS—TENOTOMY

II. FLEXION-ANKYLOSIS OF KNEE-JOINT—RESECTION BY CONCAVOCONVEX METHOD

Summary: First admission: Clinical history of patient; comments—review of course of disease; osteomyelitis *vs.* osteoperiostitis and subsynovial arthritis; Brodie's abscess; operation—pea-sized abscess evacuated and bone-cavity encouraged to heal by Schede blood-clot method; subcutaneous tenotomy of tendo Achillis and posterior capsulotomy of ankle-joint.

Second admission: Excessive periarticular cicatricial tissue contraindicates arthroplasty, while free interposing flaps are unsatisfactory in knee-joint arthroplasty; operation—resection by concavoconvex method—patella excised; advantages of concavoconvex method.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-two years of age, was admitted to Mercy Hospital June 15, 1915. Twenty years previously he suffered an attack of typhoid fever. The family history reveals neither tuberculosis nor malignancy.

Nineteen years ago, on May 7, 1896, the patient went fishing and waded in cold water up to his waist. One week later, on May 14th, a sharp pain suddenly appeared in the left tibia, 4 inches below the knee, and was followed after the lapse of six hours by fever with intermittent delirium: there was a chill which lasted half an hour.

On May 17th, three days (seventy-two hours—*cf.* Fig. 27, *6*, vol. v, February, 1916) after the onset of the pain, the tibia was curetted and a drainage-tube was inserted. After the operation the patient remained in bed eight months, and the wound discharged pus for eighteen months. On finally getting out of bed, the left knee was found ankylosed at an obtuse angle (Fig. 31, *6, loc. supra cit.*).

About three years after the first operation the wound re-opened itself and began to discharge again: a second operation was performed, and sequestra were removed from the tibia and additional ones were discharged from the wound later.

During the ensuing sixteen years, at intervals of from six months to two years, there have been numerous recurrences, the last one taking place in August, 1914. Each recurrence is manifested by sharp pain in the leg,—usually near the ankle,—fever, and then swelling. After incision of the swelling pus was discharged for two or three weeks. Chills were never present.

Nearly two years ago, on September 1, 1913, a sharp pain appeared in the left thigh and lasted three weeks. Three weeks later, on September 21st, there was soreness in the left sacro-iliac region, which lasted four weeks: stooping aggravated the pain.

One year ago, on June 14, 1914, dull pain appeared in the left thigh, and in two weeks extended to the left sacro-iliac region: stooping again aggravated the pain, and chills and fever were again absent. The next day, after riding over rough roads for a distance of 30 miles, the patient was laid up in bed for three weeks, and during this time there was a fever of 104° F. Seven weeks later, on August 4, 1914, a pint of pus was evacuated through an incision in the upper left gluteal region, and pus continued to be discharged for two weeks thereafter. Seven months ago, on November 20, 1914, soreness reappeared in this region and has remained there since.

Examination by Dr. Murphy (December 21, 1914).—The sinus over the left sacro-iliac synchondrosis is now entirely healed: motion in both hips is perfect. The existing focus of infection is three inches above the lower end of the tibia. There is a posterior subluxation of the left tibia. There is also ankylosis of the left knee-joint, arthroplasty upon which will be difficult owing to the large amount of periarticular cicatricial tissue, which will interfere with fashioning interposing flaps. The skiagram reveals the site of recurrent osteomyelitis in the tibia: the other foci have all subsided.

COMMENTS

Dr. Murphy (June 18, 1915): This patient is suffering from not only ankylosis of the left knee-joint with great deformity, but also an abscess in the lower end of the tibia and contracture of the tendo Achillis.

The clinical history tells us that there was infection of the tibia following exposure to cold. After sequestra were removed by curettage there were recurrences during the next ten years. When fourteen years of age, the patient suffered from fever with delirium, chills, and pain in the lumbar region. That is the clinical course of chronic recurring osteomyelitis, is it not? The bone was exposed and scraped—**scraped** is printed in black letters, because the term implies the presence of osteoperiostitis alone, and hence suggests that a mere superficial attack upon the periosteum suffices for cure.

You see, the surgeon who performed the first operation merely curetted the *surface* of the bone, *but did not open into the medullary cavity:* he had the right idea, but it was not deep enough—he was "in the right church, but the wrong pew." It was not metastatic osteoperiostitis, for that *per se* is a very rare condition. Syphilitic osteoperiostitis—which is a fairly common condition—is never associated with chills, nor with high fever or delirium; but metastatic osteomyelitis *is* associated with those symptoms with the greatest uniformity, and 19 times out of 20 is first diagnosed as "rheumatism" and then treated as "rheumatism." Metastatic subsynovial arthritis begins in identically the same way, namely, with a chill, high fever, and pain in the neighborhood of the joint, but in acute articular rheumatic fever there is always early effusion in the joint, while in metastatic osteomyelitis in close proximity to the joint intra-articular effusion is delayed. In the one, joint-effusion occurs early, while in the other, if joint-effusion occurs at all, it is late, as is shown in the history of this patient, who, however, was operated upon unusually early (*i.e.*, three days (seventy-two hours) after the attack began)—so early that I think the history must be misleading on this point. In osteomyelitis the rule is that elevation of the periosteum and superlative superficial redness are not manifested until seventy-two hours after the infection in the medulla of the bone has taken place.

Now what happened subsequently? The infection extended upward through the medulla, outward to beneath the periosteum, and then worked its way around the epiphysis into the knee-joint, which it infected and eventually ankylosed.

In children osteomyelitis always begins in the metaphysis—that is, it always begins on the *shaft* side of the epiphyseal line, which is a cartilaginous line, and therefore never easily attacked or destroyed by infection. A focus of osteomyelitis that begins close to the epiphyseal line nearly always spreads *toward* the shaft side and practically never *through* the epiphyseal cartilage into the joint, but around it, as was described above.

The ankylosis of the knee-joint occurred when the patient was only eighteen years of age,—while he was still in the cartilaginous epiphyseal age,—so that the epiphyseal line was invaded and eventually its cartilage disappeared, resulting in the present deformity. Had the limb been kept straight during the inflammatory stage, the patient would now have a perfectly straight limb—as good a limb as I hope to render him by operative means.

How was this lesion managed in the first instance? We learned that the periosteum was opened early: that was fine, and just as it should have been *had osteoperiostitis alone been present.* The subsequent discharge of sequestra, however, showed that the original lesion was osteomyelitis and not osteoperiostitis, so that had the first operation been performed on the first (within twenty-four hours) or second day (within forty-eight hours) after the onset of the bone-infection,—preferably within the first twenty-four hours,—and had the bone been trephined that early, the patient would not have had to undergo this long period of incapacity, extending over all these years: he has been incapacitated for nineteen years, and in his present state is a cripple. Why? Because the original diagnosis of osteomyelitis, or pus within the medulla, was not made.

In acute bacterial osteomyelitis, then, all you have to do is drill a hole into the medulla with a gimlet or a jack-knife, or any instrument that is to hand, and let the pus out early. That is why it is so important to establish an early diagnosis.

So, too, owing to failure to secure the foot at a right angle to the leg, contracture of the tendo Achillis took place during the inflammatory stage.

There have been recurrences of the infection, which are very common after the primary attack of osteomyelitis, owing to the infection becoming encapsulated and thereby retained for many years. I once operated upon a case of osteomyelitis that opened itself up twenty-seven years after the primary infection of the bone, and at operation I found that the abscess was encapsulated and the bone around it eburnated, corresponding to the condition described by Sir Benjamin Brodie in 1832, before the Medical and Chirurgical Society of London.

FIRST OPERATION

[Tibia exposed through incision over its inner subcutaneous surface: retraction of wound margins.] . . . Here is the orifice of the sinus that has been discharging so long, the abscess having burrowed from behind to before. The periosteum over the diseased portion of the bone is thickened and adherent, and, as is usual in these chronic cases, overlies an area of subperiosteal bone proliferation, which is indicative of the osteogenesis that took place between the periosteum and the bone, after the former had been elevated by the inflammatory action. [Curettes cortical bone and enters abscess-cavity.] . . . That bone is all eburnated: the abscess is no larger than a pea, and yet such a small central focus is quite responsible for the maintenance of the discharge. There is an area of granulation in the center; here is the line of demarcation between the compact bony tissue that formed around the area of suppuration and the normal medulla above. I want to curette this little cavity and swab it with 5 per cent. phenol: I shall let it heal by a blood-clot, after the Schede plan. I think that there is sufficient nourishment in this skin-flap to prevent its becoming gangrenous, and I have not injured it much during the operation. [Closes wound without a drain.]

Recapitulation.—Let the record show that the incision was placed over the inner, subcutaneous surface of the tibia; that the flap was raised from the tibial surface, the periosteum elevated, and the bone exposed; that there was much subperiosteal thickening and eburnation of the bone, inclosing a small abscess the size of a pea, which was opened, curetted, and sterilized with 5 per cent. phenol; that the deep tissues were then approximated with catgut sutures, so as not to leave a dead space outside of the bone; and finally that the skin-margins were approximated with horse-hair sutures.

At the site of the incision there was a thick, well-nourished, adipose-cutaneous flap, which afforded favorable conditions for firm, primary union of the soft parts. There is no tendency to inversion or eversion of the wound-edges. By employing the Schede blood-clot method we hope to effect rapid filling-in of the abscess-cavity.

To restore the foot to its normal position I am going to tenotomize the tendo Achillis subcutaneously. [Introduces tenotome through nick in skin and "saws" the tense tendon.] . . . As I cut, you hear the tendon yield.

We must also divide the posterior capsule of the ankle-joint, which shortened from contraction when the patient was a young boy. [Divides posterior portion of capsule.] . . . Now the foot may be brought to a right angle to the leg without tension. After division the two ends of the tendo Achillis slide past each other, leaving a gap; but, by splitting this tendon within its sheath, the ends never get too far apart to unite subsequently (Figs. 173, 174, vol. iii, June, 1914, pp. 506 and 507).

After the lapse of two weeks we intend operating upon the knee-joint with a view toward obtaining a straight, stiff knee, correcting the flexion-deformity by employing the concavoconvex method of resection.

SECOND ADMISSION

Dr. Murphy (September 2, 1915).—In the present state of the soft tissues about the knee—scarred from old, healed sinuses—I shall be unable to perform arthroplasty and render a movable joint, because there is available no loose tissue in the midline from which I could make an interposing flap; and free flaps obtained from distant regions have been unsatisfactory.

Many years ago we thought that it would be the ideal operation to transplant free flaps of fascia and fat and interpose them between the ends of the bones; and in the two cases in which we used such flaps in the knee-joint,—while they healed in primarily, and in the beginning a very good range of motion was obtained,—finally the motion became more and more limited, until eventually fibrous ankylosis resulted, although in neither case did the bony ankylosis return.

With this patient the operative indication is to establish a straight, stiff knee on which he will be able to walk. We have already tenotomized the tendo Achillis and brought the foot around into right-angle relationship with the leg. We shall perform concavoconvex resection, according to the method which has been previously described (vol. iv, October, 1915, pp. 993–1006). With a curved chisel we shall resect the lower end of the femur in a convex manner and the tibia in a concave manner, so that the convexity of the resected femur accurately fits into the concavity of the resected tibia: the key to a good result is always to maintain the same arc for both bone-ends.

SECOND OPERATION

[Applies constrictor to thigh.] There is the articular line between the femur and the tibia. [Cuts through plane of ankylosis with chisel.] . . . By using the large, curved chisel I am able to get the desired concavoconvex conformation right away, and to maintain it. I must remove that sclerosed, compact bony tissue until I reach healthy, cancellous bone, so as to establish the most favorable conditions for union. For a like reason the fibrous tissue filling in the intercondyloid notch is removed—in fact, I am freshening all the bone surfaces. I wish to bring the tibia into almost complete extension, preserving the smallest degree of flexion, for the limb functions most serviceably when ankylosed in a position just short of full extension of the leg upon the thigh.

The patella projects on the inner side and interferes with the contour of the limb, so we are excising it, freeing it from the quadriceps tendon above and the ligamentum patellæ below. . . . Now we have the ends of the femur and tibia properly developed and in good apposition.

The advantage of the concavoconvex approximation is that, no matter how we adjust the tibia to the femur, the approximated bone-ends contact throughout at all tangents. Formerly we squared the ends of the bones, but by that method the slightest alteration in the flexion-extension angle caused separation of the surfaces. By the concavoconvex method, however, separation of the surfaces, or anteroposterior luxation, cannot occur, because the convex surface fits perfectly into the concave one, since the arc of each surface is of the same degree. I consider this concavoconvex method a great improvement over the classic method of squaring off the bone-ends in resection of the knee-joint, and so far we have obtained splendid results with it.

[Removes constrictor.] There is no bleeding and, as usual, no ligatures need be applied.

Before the operation there was a slight degree of abduction of the leg, but we have so altered that as to leave a slight degree of adduction. The resected bone-ends require neither nailing nor wiring for their fixation: it suffices to suture the capsule.

The limb will now be dressed in a plaster-of-Paris case. See what an advantage that flap presents over the usual U-shaped flap, the vascularity of which is materially interfered with, and which occasionally results in gangrene of the tip of the flap. We employ this same type of flap in excision of the elbow.

Let the record show that we succeeded in performing all the operative work without hand-contacting.

Postscript.—There was primary union of soft parts and a primary bony union.

[A diagnostic talk on osteomyelitis was published in vol. iv, April, 1915, pp. 187–237; a series of sketches illustrating the rapid progress of osteomyelitis appeared in vol. v, February, 1916, pp. 173–176.]

BOWLEGS (GENU VARUM)—CUNEIFORM OSTEOTOMY OF TIBIÆ

Summary: Clinical history of patient; comments—discussion of deformity; treatment according to age—osteoclasis, linear and cuneiform osteotomy; dangers of osteotomy—infection, non-union; operation—cuneiform osteotomy of both tibiæ; extent of immobilization-dressing required.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-nine years of age, was admitted to Mercy Hospital May 22, 1915.

Both legs have been bowed since the patient was four years of age. When he stands straight with the tibial malleoli in contact, the distance between the tibiæ—reckoned from a point two inches below the tubercles, which is the site of greatest deviation—is four inches; while with the limbs in the same position the internal femoral condyles are two inches apart.

COMMENTS

DR. MURPHY (May 29, 1915): This is a case of double genu varum. The deformity is almost entirely confined to the upper four inches of the tibiæ: there is practically no deformity in the femora. When the ankles are placed together, the knees are four inches apart and the ligaments of the knee-joint are subjected to tension. The spread is continually increasing, and is distributed almost equally on both sides.

In the management of *genu varum* one must take into consideration the age of the patient. In children, for example, the best procedure is osteoclasis, of which there are many methods; but it does not matter which method you employ, provided it is the one which will accomplish your purpose. The rule is that in children less than three years of age you can effect correction best by osteoclasis; and in those beyond that age—and up to fourteen years—by osteotomy. In adolescents beyond the age of fourteen years you have the choice of a sawing or chiseling operation, or cuneiform osteotomy—that is, partial section of the tibia in a V-shaped manner, so that, after fracturing the bone, the liability of lateral displacement occurring to any great degree does not exist.

This is the plan which we devised originally when dealing with ancient fractures and luxations with deformities near joints which required correction. For example, we use it in correcting the deformity in ancient Colles's fractures. Instead of cutting the bone across the plane of fracture, however, we cut it in the shape of a V, which leaves a sharp point from above fitting into the V shape below—the A fits into the V and is grasped by it, so that there is no longer any chance of displacement occurring: such is the type of osteotomy which we expect to perform in this case, and it is the one which we prefer.

In some of these cases of genu varum you will find that the deformity is not in the tibia, but in the femur. Cuneiform osteotomy in the lower end of the femur is performed in a different manner. An incision is made on the side, and the periosteum is elevated before and behind (Macewen). After correcting the deformity there results an overlapping edge, with the overlapping always situated in front, so that the contraction of the gastrocnemius muscle will not pull the upper end of the lower fragment backward, giving rise to a very bad and dangerous deformity.

In performing these osteotomies, what are the dangers? First and foremost is that of infection. The reason orthopedists prefer osteoclasis—which traumatizes the tissues much more than the cutting operation—is that the danger of infection is obviated. In bone-work infection is a very important thing to guard against, for bone does not offer the resistance to infection that the peritoneum and other tissues offer. The second danger is that of non-union, the liability to which may be lessened by employing this V-shaped method of division, thereby keeping the bone-ends in apposition.

What is it that contributes to the tendency to non-union? In the first instance, the nearer you keep to the end of the bone, the less the liability of non-union. Non-union of a fracture through cancellous bone is very rare, except in the neck of the femur. Another place in which non-union occurs is in the neck of the external or the internal condyle of the humerus, which does not consist of cancellous tissue, but of compact bony tissue, as may be demonstrated at any time by reference to the skeleton. I believe that cases of non-union have been increasing because of the too perfect immobilization of fractures which is obtained by the present method of dressing: in other words, I believe that a certain amount of motion is advantageous in promoting osteogenesis at the line of fracture, and of this we are convinced by comparing the frequency of non-union thirty and thirty-five years ago with that of the present time; and again by noting the frequency of non-union after the most accurate apposition of the fragments to each other. This situation has been illustrated by case after case: some of you who were present the other day saw the case in which there was very good apposition of the fragments with slight angulation, but not the slightest effort at osteogenesis. A Lane plate had been accurately applied and under aseptic precautions, but still there was not the slightest effort at union. Such cases were fixed with either a plate or plaster case, which both produce absolute immobilization.

In fractures in animals there may result deformity from vicious union, but the occurrence of non-union is very rare, considering that in animals no dressing whatever is applied. Before we began to use the plaster-of-Paris case in the immobilization of fractures we rarely saw non-union. In my service at the Cook County Hospital, in the twenty months during which I was an intern, we saw just one case of non-union, and it was the talk of the hospital at that time.

OPERATION

We are applying a constrictor to the thigh because it saves time and prevents blood coming into the field and obstructing the view when making the V-shaped division. I think we can divide the bone better with the chisel than with the saw. After having avoided the danger of non-union, the next thing is to avoid overcorrection of the deformity. I am not sure that I shall have to fracture the fibula, because of the proximity of the site of osteotomy of the tibia to the head of the fibula; but if the site of osteotomy were lower down,—for example, in the middle of the tibia,—then I would have to fracture the fibula in order to be able to effect the proper degree of correction. It is not often that these bow-legged patients come to us for operation so late in life as this patient, who is twenty-nine years of age: we much prefer to operate upon such deformities earlier in the patients' lives.

I shall deal with the right leg first. [Nick made through skin for passage of osteotome.] . . . I am splitting the periosteum where I wish to elevate it. [Elevates periosteum.] . . . A blood-clot will form beneath that periosteum and will accelerate firm bony union. [Performs cuneiform osteotomy of tibia.]

Let the record show that the tibia was easily fractured; that we made an A-V-shaped division of it; and that it was unnecessary to fracture the fibula. You just make an A-V division and the V fits into the A. You can use a double A or a double V, depending upon the way in which one regards it.

* * * * * *

Now we shall deal with the left leg, following the same plan as before. I am dividing the periosteum and elevating it just above and below the line of bone-division, because I believe that such an elevation increases the chances of union. In correcting this bowleg deformity one must always slightly rotate the foot externally; and to avoid postoperative rotation the plaster-of-Paris dressing must extend clear up to the hip and clear down to and including the foot. We seal the wound with powder and collodion, keeping it sealed for two or three weeks. At the end of that time we shall examine the legs to see if further manual correction is indicated.

In all our bone-work—especially that involving the medulla—it is astonishing to me that up to the present time we have had no cases of fat-embolism. A slight hematoma will form here and require aspiration.

Let the record show that we succeeded in performing both operations without having the hand contact with the wound and without having the instrument contact with the wound at the part where it had touched the hand.

Postscript.—Dr. Murphy (June 23, 1915): It is almost four weeks since we operated upon this patient for double genu varum. [Removes fixation-dressings.] The left leg is now perfectly straight, and one can scarcely see where the bone was fractured at operation. There is no great stiffness in the left knee. The right leg calls for a slight degree of manual correction. Now we shall apply new gypsum cases.

Postscript.—There was primary union on both sides, and the patient was permitted to walk eight weeks after the operation.

ANCIENT TRAUMATIC LOSS OF SUBSTANCE OF TIBIALIS ANTICUS MUSCLE—REPAIR BY TUBE OF FASCIA LATA WITH FAT—TENOTOMY OF TENDO ACHILLIS

Summary: Clinical history of patient; comments—condition of leg since previous operation; degree of present loss of function and unfolding of plan to restore it; operation—sheath of fascia lata bearing fat wrapped about divided muscle; tenotomy of tendo Achillis.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-six years of age, was readmitted to Mercy Hospital October 1, 1915. About nine months previously, on December 23, 1914, the patient was operated upon by Dr. Murphy for a friction-burn (mine accident) of the left leg. The burn involved an area which extended upward for three inches from the base of the fibular malleolus, and which destroyed in its path all structures as far inward as the inner two-thirds of the tibia, resulting in a semilunar defect concave externally. Thus there were destroyed successively the skin, the superficial fascia, the deep fascia, the peroneal tendons, the fibula, the extensor tendons, the outer third of the tibia, and the outer half of the gastrocnemius and soleus muscles, forming the tendo Achillis. The accident occurred six months previously. The operation consisted of denuding the ulcer of cicatricial tissue and covering it over with a pedicled flap obtained from the outer aspect of the opposite thigh, just above the knee. During the process of healing the left ankle was held in contact with the right thigh by means of a plaster-of-Paris fixation-dressing. (For complete report consult vol. iv, June, 1915, 463–468—steps of operation illustrated by five figures on p. 466.)

The following postscript was added to the narrative as given above. "The flap healed in *per primam.* The pedicle was detached over half its area on the thirteenth day, and completely separated on the fifteenth day. The area was completely covered with normal skin containing a pad of fat ½ to ¾ of an inch thick."

Now the patient is unable either to evert (peroneals destroyed!) or extend (tibialis anticus, etc., destroyed!) the foot: the foot, therefore, rests in the position of flexion and inversion.

COMMENTS

Dr. Murphy (October 7, 1915): By the previous operation we succeeded in filling in with a cushion of fat and skin the excavation left remaining after the friction-burn: the bone, too, has developed in accord with Wolff's law, so that the leg above the ankle has regained nearly its normal girth. Although the patient is able to use his foot in locomotion, yet, owing to the destruction of the extensor tendons, he is unable to elevate it: the foot resembles one the victim of peroneal palsy—a classic condition. The next operative procedure, therefore, is to reëstablish the function of the severed tibialis anticus muscle, rendering to the patient the power of elevating (extending) the foot.

The plan of the present operation is first to expose the tendinous portion of the tibialis anticus below the site of the graft; secondly, to expose the muscular portion of the same above the site of the graft; thirdly, to free both these structures; fourthly, to tunnel beneath the skin-flap graft; and, finally, to bridge the gap in the muscle by a sheath of fascia lata, which sheath is to occupy the tunnel resulting from step No. 4. The foot will be aided in its new excursion upward by performing tenotomy of the tendo Achillis.

OPERATION

[Exposes tendon of tibialis anticus below site of graft.] . . . You can see that the tendon is fixed to the bone from the cicatricial tissue following the burn. [Frees tendon.] . . . Now let us search for the muscular portion above the site of the graft. . . . It is fixed to the fibula. [Frees muscle from fibula down to its end and then tenotomizes tendo Achillis subcutaneously (see Fig. 58 *1,2*, p. 330).] . . .

Having freed the muscular and tendinous ends of the tibialis anticus from their cicatricial fixations, we must enwrap them in a material which will not only form an obstacle to their readherence to the bed of cicatricial tissue, but also establish the continuity of the severed ends: for this purpose we shall utilize a free transplant of fascia lata, with its overlying fat, contacting the fibrous side with the muscle and tendon and the fatty side with the surrounding cicatricial tissue, and then stitching the vertical edges of the transplant to each other and the upper and lower edges to the muscular and tendinous portions, respectively (Fig. 57). The

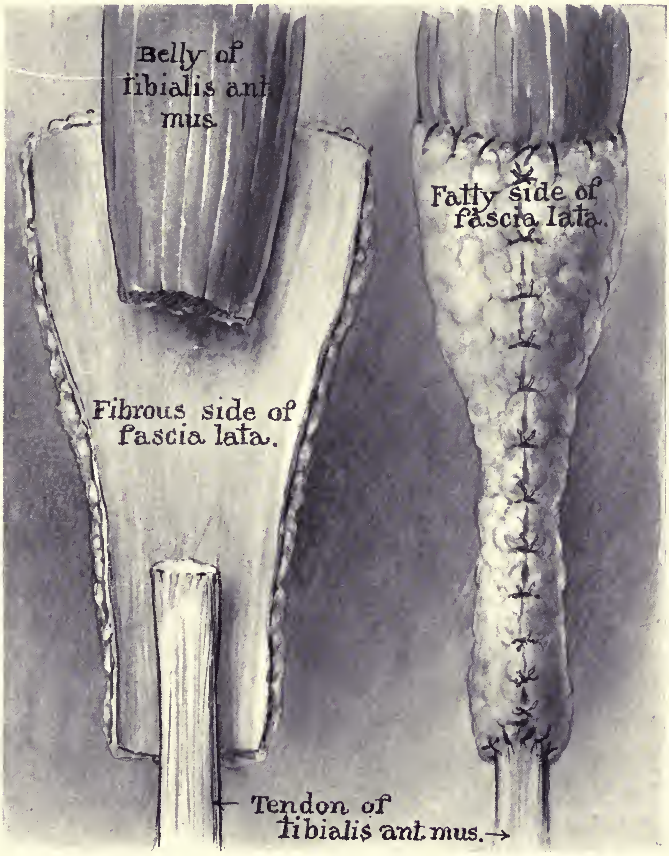
Belly of tibialis ant. mus.
Fatty side of fascia lata.
Fibrous side of fascia lata.
Tendon of tibialis ant. mus.

Fig. 57.—Repair of tibialis anticus muscle.

fat will play the rlôe of a tendon-sheath by affording the muscle free play in its upward and downward movements.

[Removes from thigh a strip of fascia lata measuring 1¼ inches in width, whose external surface bore a thick layer of fat and whose inner portion included a part of the tensor fasciæ latæ muscle; converts fascial transplant into a funnel-shaped tube, whose broad, upper end surrounded the lower two inches of the muscular portion of the tibialis anticus, and whose narrow lower end, having been passed through the subcutaneous tunnel previously made through the skin-graft, surrounded the upper 1¼ inches of the tendinous portion; accurately stitches the four edges of the transplant with interrupted threads in the manner described above, and as shown by the figure; closes superficial wound without inserting drainage and applies dressing; closes incision in thigh, through which strip of fascia lata was obtained.]

Postscript (*October 19, 1915*).—The stitches were removed today: the wound is healed *per primam*. When the patient was ready to leave the hospital, there was already pronounced dorsal extension of the foot through the contractions of the tibialis anticus muscle.

SPASTIC (CEREBRAL) PARALYSIS—TENDON-TRANSFERENCE (PERONEUS LONGUS)—ELONGATION OF FLEXOR TENDONS—FASCIOTOMY (PLANTAR FASCIA)

Summary: Clinical history of patient; comments—nature of lesion; the operations of Förster and of Stöffel; characters of talipes equinovarus; plan of operation in this case; operation—tenotomy and elongation of tendo Achillis; transference of peroneus longus tendon; elongation of tendons behind tibial malleolus; fasciotomy of plantar fascia; treatment of contractured hand; postoperative comments—great possibilities of tenoplasty.

CLINICAL HISTORY OF PATIENT

A FEMALE, sixteen years of age, was admitted to Mercy Hospital November 20, 1915. The family history reveals that one brother and one sister died of pulmonary tuberculosis at the respective ages of twenty-one and nineteen years. The past history reveals no illness that bears upon the present condition.

When the patient began to creep in infancy, there was noticed faulty movement of the left hand and leg. She is the youngest of seven children, and, so far as it is known, her birth was normal. The lesion was not preceded by any postnatal illness; the only treatment it received was that of the support afforded by an ankle-brace, which was worn for but a short time.

Examination by Dr. Murphy (November 16, 1915).—With the knee flexed, the foot can be restored to its normal position; but when it is extended, the foot goes into the position of talipes equinovarus, from which position it cannot be dislodged without flexing the knee again. In extension, too, the tendo Achillis tenses and becomes spastic (contraction of gastrocnemius and soleus); so, also, the tibialis anticus, though intact and strong, contributes to the varus deformity by its tense and spastic condition: none of the muscles of the leg, however, is paralyzed.

There is some coördinate movement of the arm and leg on the left side; the flexors of the hand are all contractured.

COMMENTS

Dr. Murphy (November 24, 1915): The lesion from which the patient suffers is that of spastic (cerebral) paralysis: it is an upper motor neuron lesion, due, in all probability, to subdural hemorrhage the result of a protracted labor; that it is not a lower motor neuron lesion is shown by the absence of flaccidity of muscles, which characterizes the lower lesion. The upper (cerebral) lesion is characterized by hyperirritability (spasticity) of muscles with exaggerated reflexes: under these circumstances contractions of the stronger groups excel those of the weaker antagonizers; and since the flexor groups are the stronger, the various segments of both the upper and the lower extremity will be found the seat of flexion-contracture. Thus in this case we find the calf muscles and the underlying flexors contracted, accounting for the talipes equinovarus, which is relieved when the leg is flexed upon the thigh through the coincident relaxation of the calf-muscles and the release of the foot from the grip of the tendo Achillis. In consequence of the upper motor neuron lesion there arises descending degeneration of the pyramidal tracts of the spinal cord.

It was for this lesion that Förster, in 1913, divided the sensory (posterior) rootlets of the regional spinal neves: owing to the abolishment of the function of muscle-sense the reflexes and therefore the spasticity disappear. I do not consider our case severe enough for such an heroic measure. It is of interest to note that Stöffel, in 1912, proposed section of peripheral motor nerves between their parent trunk and the muscles which they supply.

When this girl is asleep, there is no noticeable deformity, but when up and about, the predominant flexor muscles of the foot go into action and become spasmodic, the contracted tendo Achillis accounting for the equinus and the contracted flexors and tibialis anticus for the varus, so that when walking the patient progresses upon the outer border of the flexed foot (talipes equinovarus). This type of talipes constitutes 77.4 per cent. of all deformities of the foot, congenital and acquired.

The operative plan is clearly to elongate the flexors of the foot and to neutralize the spasm of the tibialis anticus by, for example, transferring the traction-axis of the peroneus longus tendon to a more anterior position (in front of the fibular malleolus), and the insertion of the tendon itself from the inner to the outer border of the foot. The plantar fascia will also be divided (fasciotomy).

OPERATION

[Tendo Achillis divided and elongated (Fig. 58, *1*, *2*), as described in previous case (see p. 314).] . . . The next step is to transfer the peroneus longus tendon. [Horizontal incision made over base of fifth metatarsal bone, extending slightly behind it, retraction of wound, exposing peroneus longus and brevis tendons (Fig. 58, *3*).] . . . I sever the tendon of the peroneus longus proximal to its fibrocartilage and attach the distal end to the still-intact tendon of the peroneus brevis, thereby preserving its function; I then withdraw the proximal end of the tendon through a vertical incision 3½ inches higher up, pass it downward through a subcutaneous tunnel before the fibular malleolus, and attach it to the dorsal cubometatarsal ligament (Fig. 59, *4*, *B*, *A*). The proximal portion of the peroneus longus will henceforth act as an extensor and evertor, instead of a flexor and evertor. [Closes external horizontal and vertical incisions; makes vertical incision behind tibial malleolus.] . . .

It remains to elongate the contractured flexor tendons. As I retract the wound-edges you can see the internal annular ligament, and as I incise and retract it in turn the structures between the malleolus and the tuberosity of the os calcis appear: the posterior tibial nerve is distinguished by its position between the artery and the flexor hallucis longus tendon, and by its duller, white, ribbed appearance contrasted with the glistening and yellower appearance of the tendons. [Elongates, in turn, the tendons of the tibialis posticus and flexores digitorum et hallucis longus, according to the scheme shown in the cut (Fig. 59, *5*), and then closes wound without inserting drainage.] . . . It re-

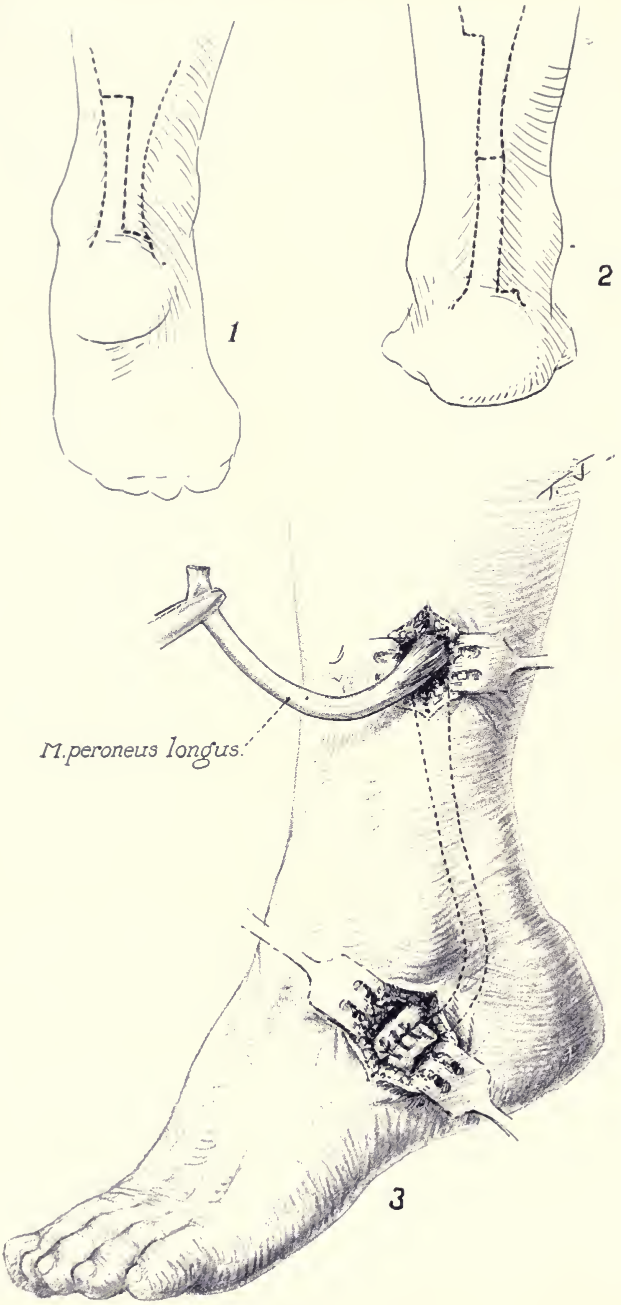

Fig. 58.

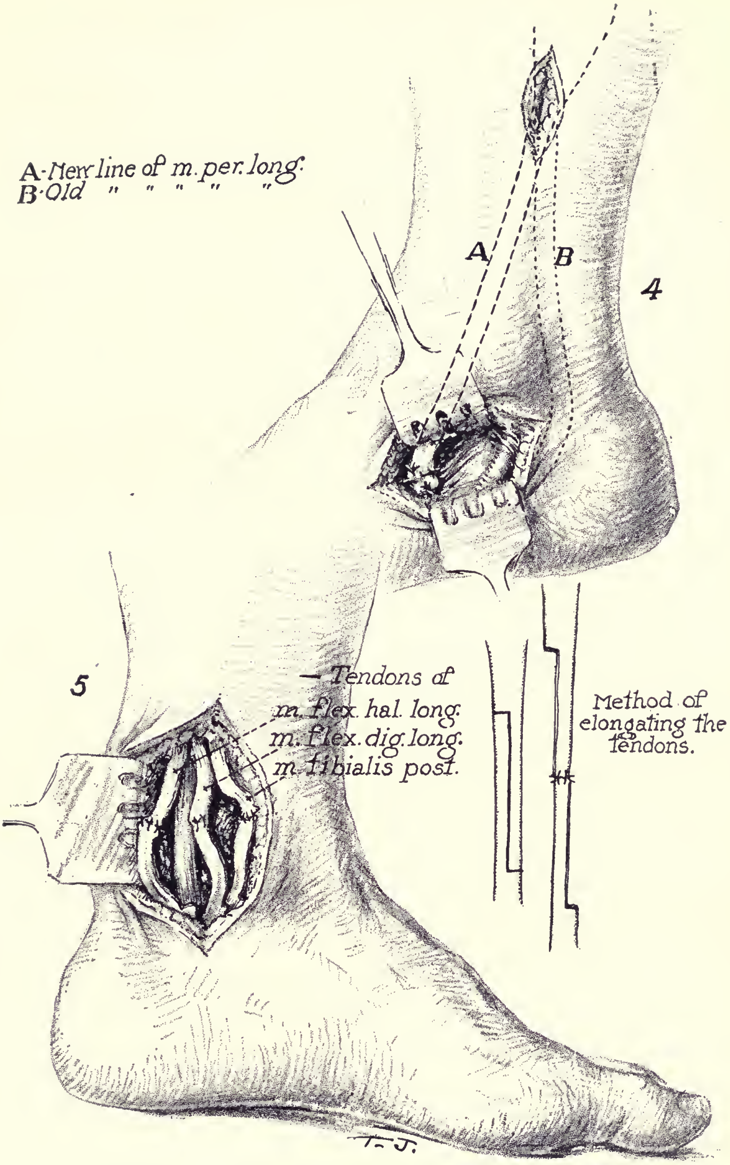
A·New line of m. per. long.
B·Old " " " " "
A
B
4
5
Tendons of
m. flex. hal. long.
m. flex. dig. long.
m. tibialis post.
Method of elongating the tendons.
T. J.

Fig. 59.

mains for us to divide the plantar fascia subcutaneously (Fig. 63, *3*, p. 342). [Applies fixation-dressing.]

I am now stretching the flexor muscles of the hand: later we may elongate the tendon of the flexor carpi radialis.

POSTOPERATIVE COMMENTS

We believe that this operation of tendon-transference—which obviates the spinal operation of Förster—will result in enabling the patient to step flat upon her foot, and then she will be a very happy girl.

There is an enormous field for work in this class of cases: thousands of individuals are going about bearing their crippling deformities unnecessarily from lack of attention and medical interest in their case. It is the old story of the commoner maladies being neglected for the rarer.

Postscript.—The patient made an uneventful recovery. On leaving hospital she was able to place her foot flat upon the ground: the gypsum case was reapplied, however. A splint was applied to the forearm to counteract the contracture, and the patient was advised to use the hand as much as possible.

INFANTILE PARALYSIS (LEG)—TENDON-TRANSFERENCE

Summary: Clinical history of patient; comments—estimation of extent of paralysis in leg; outline of plan of operation; operation—non-use of iodin in children's skin; tenotomy of tendo Achillis; transplantation of tibialis posticus tendon to tibialis anticus, and of peroneus longus to toe-extensors as well as to union of former tendons; actual strength of tibialis posticus when transplanted problematic; postoperative comments—tendon-transference for focal paralysis a very successful form of tenoplasty.

CLINICAL HISTORY OF PATIENT

A FEMALE, six years of age, was admitted to Mercy Hospital October 7, 1915.

When three years of age (1912) the patient was suddenly taken ill with fever and severe headache: the fever continued four days and was accompanied by slight intermittent delirium; the bowels were constipated. By the fourth day of the illness the parents noticed that the patient had lost control of both lower extremities.

One week after the subsidence of the fever motion began to be restored to the right leg, which now seems to function normally. The left leg, too, began to recover itself, but decidedly lagged behind its fellow, and at present it cannot be extended and tends to rotate outward.

Examination by Dr. Murphy (October 7, 1915).—Of the four groups of muscles of the leg, the extensor group alone has suffered, and in this group a moderate degree of power has returned to the extensors of the toes, of which the extensor hallucis proprius seems to be the weakest. Intact are the muscles of the calf group: those of the flexor group; and those of the peroneal group. Of the muscles of the thigh, those of the quadriceps extensor group are only slightly impaired in power, and those of the remaining groups are normal.

COMMENTS

Dr. Murphy (October 9, 1915): Owing to the return of a moderate degree of power to the extensor muscles of the toes,—the degree of power increasing progressively from the great toe, where it is least, to the little toe, where it is greatest,—the patient is enabled primarily to extend the toes (within these limitations) and, through extension of the toes, to extend the foot as a secondary action. On account of the integrity of the posterior (flexor) muscles the foot cultivates the position of talipes equinus

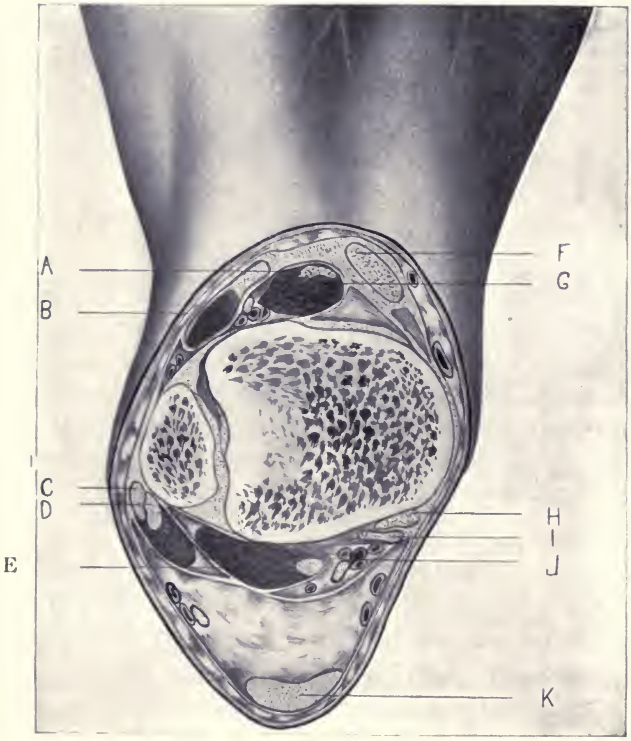

Fig. 60.—Cross-section just above right ankle. A, Extensor hallucis proprius; B, anterior tibial vessels and nerve (this leader crosses extensor digitorum longus); C, peroneus brevis; D, peroneus longus; E, flexor hallucis proprius; F, tibialis anticus; G, extensor proprius hallucis; H, tibialis posticus; I, flexor digitorum longus; J, posterior tibial vessels and nerve; K, tendo Achillis (modified from Braune: Keen's Surgery).

the strong antagonizer of the flexors—the tibialis anticus—is totally paralyzed; it is evident, then, that reënforcements are needed to succor the crippled extensors of the toes, which alone—and merely through their feeble secondary action—are resisting the pull of the more powerful posterior muscles.

The weakened extensor power may be strengthened by performing tenotomy and tenoplasty: tenotomy of the tendo Achillis, in order temporarily to suspend the extension-resisting pull of the calf muscles, and tenoplasty with tendon transference of the nearest powerful tendons of the posterior group which are available. Reference to the accompanying cut (Fig. 60) shows the relations of the malleoli to the tendons under discussion. The fibular malleolus separates the extensor digitorum longus (B) before from the peroneus longus (D) behind; while the tibial malleolus separates the tibialis anticus (F) before from the tibialis posticus (H) behind. The most logical plan of transference for the end in view, therefore, is to advance the peroneus longus to the extensor digitorum longus and the tibialis posticus to the tibialis anticus.

OPERATION

In disinfecting the skin in children we prefer alcohol to iodin, for by blistering the skin with iodin, thus predisposing it to pustular dermatitis, the latter may establish an infected skin-area, and in the presence of infection plastic operations usually fail.

In accord with our plan of operation the first step is that of subcutaneous tenotomy with lengthening of the tendo Achillis: this is performed by cutting halfway through the tendon on opposite sides at different levels and then splitting the tendon vertically in its middle between the two horizontal lines of hemisection (Fig. 61, *1*). First the tendon is made tense by extending the foot; secondly, three small skin punctures are made: one at the inner border of the tendon, just above the os calcis, dividing the inner half as far as the middle; the second at the outer border of the tendon, two inches above the first, dividing the outer half as far as the middle; and the third at the level of the first, over the midline of the tendon, dividing the latter vertically upward from the lower to the upper hemisection. By this subcutaneous method there is no such retraction of the divided ends as follows

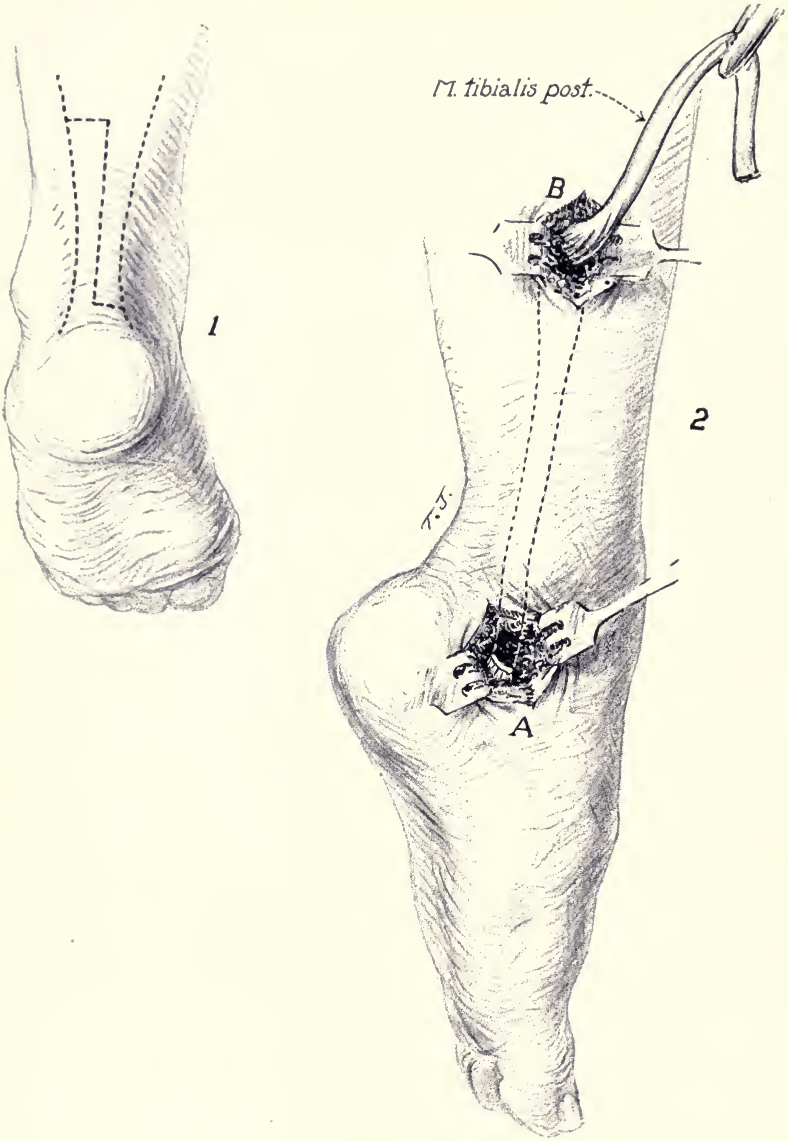

Fig. 61.

the open operation, nor is there the danger of infection or failure of union. By virtue of its thick sheath non-union of a divided tendo Achillis is among the greatest rarities.

[Horizontal incision made over tuberosity of scaphoid bone.] As I retract the edges of the wound you can see the tendon of the tibialis posticus muscle in its course from immediately behind the tibial malleolus to its insertion into first the scaphoid (Fig. 61, *2*, *A*), and then the remainder of the tarsal bones with the exception of the astragalus, and into the bases of the outer four metatarsals: its identity is established by its position immediately behind the tibial malleolus, and by the fact that when subjected to traction, the tendon does not flex the toes, as would occur were it the tendon of its neighbor, the flexor digitorum longus; the flexor hallucis longus is nearest the point of the heel, and separated from the latter tendon by the posterior tibial artery, veins, and nerve. [Severs tendon of tibialis posticus and withdraws it from its sheath through vertical incision (Fig. 61, *2*, *B*).] . . . I now have the tendon free and ready for transposition. [Closes former incision "A."] . . . I shall now go to the outer side of the foot for the tendon of the peroneus longus. [Horizontal incision over cuboid; peroneus longus tendon severed proximal to its fibrocartilage and withdrawn through a vertical incision higher up (Fig. 62, *3*).] . . . We shall not disturb the peroneus brevis, which inserts into the tuberosity of the fifth metatarsal bone, nor the peroneus tertius, which—essentially a human muscle—inserts into the dorsal aspect of the base of the same bone, and in reality is a part of the already weakened extensor group. [Closes former incision.] . . .

With both these tendons released we are ready to utilize them as reënforcements for the weakened extensor tendons. [Vertical incision made over front of leg in midline and just above malleoli (Fig. 62, *4*).] . . . As we retract the edges of the wound you can see the upper portion of the anterior annular ligament, and as we incise and retract this, in turn, there appear from within outward the tendon of the tibialis anticus, which is immediately before the tibial malleolus; the tendon of the extensor hallucis longus; the anterior tibial artery with its two venæ comites; the anterior tibial nerve, and the tendon of the extensor digitorum longus, which still consists of a single fasciculus.

Now watch how I bring up the reënforcements. I make a sub-

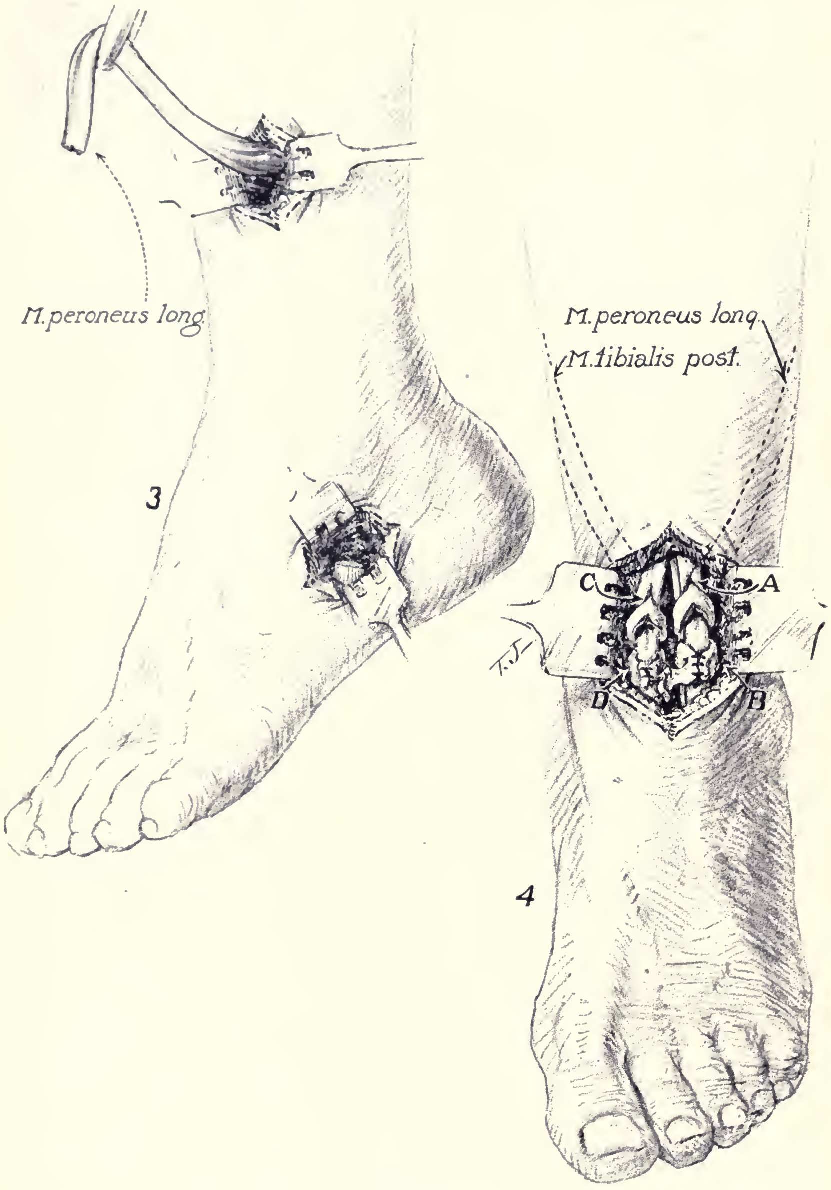

Fig. 62.

cutaneous tunnel on each side for the passage of the released tendons; draw each tendon through its own tunnel out into the wound; split the end of each transposed tendon; make a vertical perforation in the two tendons that are to be reënforced; pass the split end of each transposed tendon through its corresponding ward (Fig. 62, *4*, *A*, *C*); cross the split ends behind each tendon, bring them around anteriorly and suture them together in front, leaving one end long to be sutured to the opposite tendon (Fig. 62, *4*, *B*, *D*). In this way our operative plan is executed by having the tendon of the tibialis posticus embrace that of the tibialis anticus, and the tendon of the peroneus longus those of the extensor digitorum longus et hallucis proprius, each by a half-hitch to overcome the tendency of the tendon-sheath to slide upon itself. By leaving the inner cut end of the peroneus tendon long and attaching it to the corresponding end of the tibialis posticus tendon, the peroneus longus shares the burden of the latter: I do not trust the tibialis posticus tendon alone, for its strength and controlling power when acting independently of its colleagues—the flexor muscles—are difficult to demonstrate, but the opposite obtains for the peroneus longus tendon. Note that each transplanted tendon perforates its ward just as the flexor profundus perforates the flexor sublimis, so that a natural situation is reproduced. [Closes the three remaining open wounds and applies fixation-dressing without inserting drainage.] . . .

POSTOPERATIVE COMMENTS

By virtue of so many muscles having been left intact after an attack of acute anterior poliomyelitis this case was a very favorable one for that most gratifying type of tenoplasty—tendon-transference for focal paralysis. There is no longer any doubt about this patient's ability to extend her foot, the restoration of which power will mean a great deal to her the remainder of her life.

Postscript (*January 24, 1916*).—The wound healed *per primam*. The patient was discharged today and left hospital with the gypsum case still applied; she was able to put the foot flat upon the ground.

CONGENITAL TALIPES EQUINOVARUS—TENDON-ELONGATION (ACHILLIS)—FASCIOTOMY (PLANTAR)—TENDON-TRANSFERENCE (TIBIALIS ANTICUS)

Summary: Clinical history of patient; operation—tenotomy with lengthening of tendo Achillis; plantar fasciotomy; transference of tibialis anticus tendon to outer border of foot.

CLINICAL HISTORY OF PATIENT

A male, sixteen months of age ,was admitted to Mercy Hospital December 6, 1915. He is the youngest of five living children of healthy parents.

The patient is afflicted with a congenital talipes equinovarus on the right side. This deformity was treated first by adhesive plaster strapping and then by the application of a gypsum case, but without benefit. The patient enjoys very robust health.

OPERATION

Dr. Murphy (December 8, 1915): The unfolding of this clubfoot will be begun by tenotomy, with lengthening of the tendo Achillis. In this case the overcoming of the varus deformity may be aided by preserving the attachment of the outer portion of the tendon to the outer portion of the os calcis: the inner portion is pulling too strenuously and will be severed just above the os calcis. [Tenotomizes tendo Achillis (Fig. 63, *1*) and elongates it (Fig. 63, *2*): for description of technic, *vide supra*, p. 335.] . . . The foot having been released from the grip of the tendo Achillis, we are enabled to extend it: in this maneuver we shall at the same time stretch the posterior portion of the capsule of the ankle-joint.

To overcome the cavus deformity we must perform plantar fasciotomy (Fig. 63, *3*). This fascia is contracted, and the contracted bands are made prominent by extending the antetarsus. From the tuberosity of the os calcis the plantar fascia passes forward and spreads out toward the toes in fan-shaped manner, and shortly in front of the tuberosity the external plantar vessels and nerve cross its deep surface: hence in performing fasciotomy it is

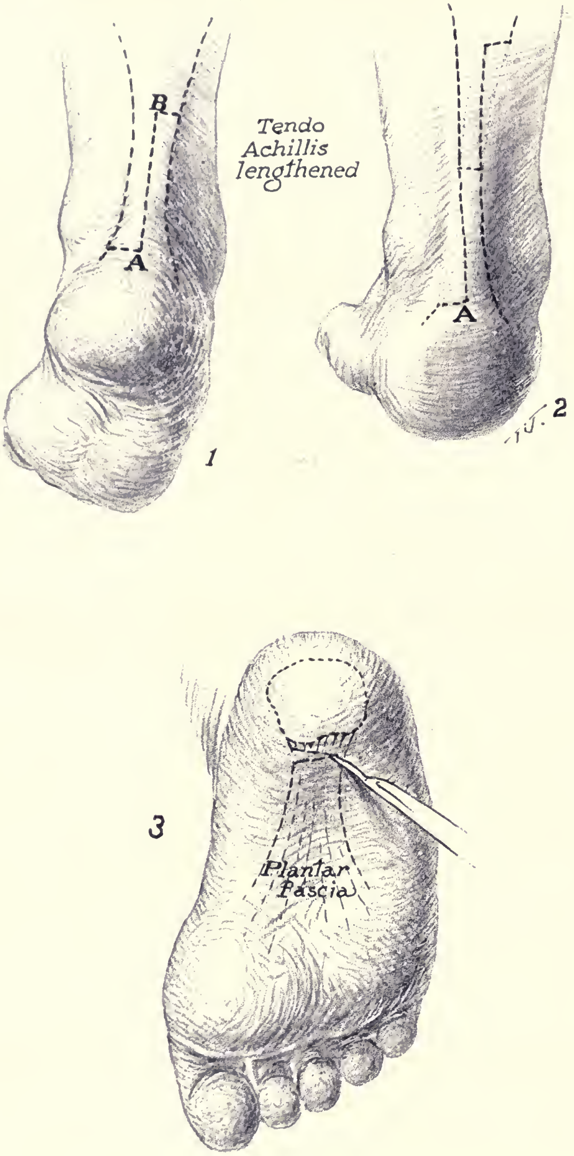

Fig. 63.

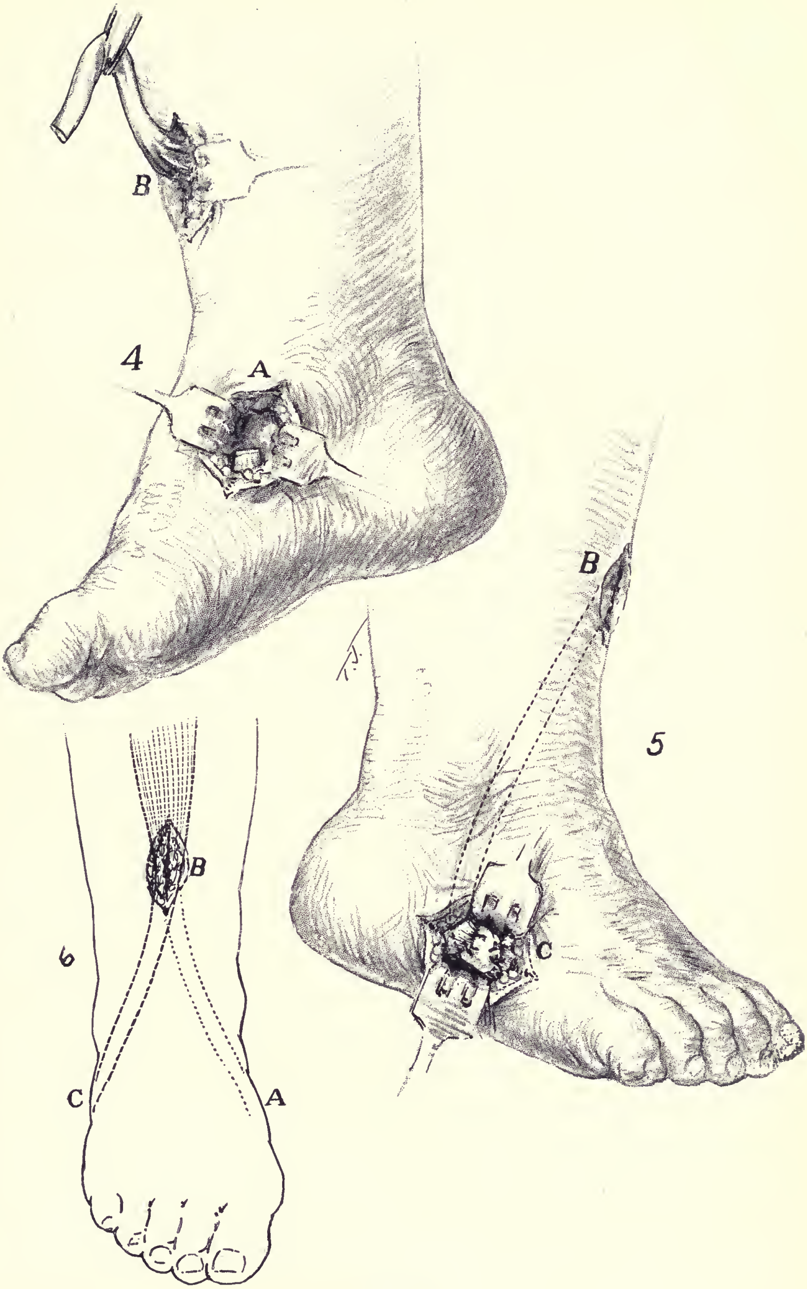

Fig. 64.

advisable to cut close to the tuberosity, both because a less extensive incision is required to sever the posterior narrow portion, and in order that the vessels and nerves may with certainty be avoided. [Through a skin-puncture opposite the outer border of the plantar fascia, and close to the tuberosity, a small scalpel is entered, passed between the skin and fascia to the inner border of the latter, and made to cut through fascia toward point of entry, as shown in cut (Fig. 63, *3*).] . . .

So far we have overcome the equinus by tenotomy with lengthening of the tendo Achillis, and the cavus by plantar fasciotomy; but with the release of the foot from the restraint maintained by these two structures the tibialis anticus muscle has been given freer play and has taken advantage of this circumstance by increasing the degree of internal rotation of the foot by its contractions: it remains, therefore, to transfer this muscle from the inner to the outer border of the foot (Fig. 64, *4*, *5*, *6*), thus converting it from an *ad*ducting extensor into an *ab*ducting extensor, and at the same time overcoming the varus. [Oblique incision made on dorsum of foot over course of tibialis anticus tendon, close to its insertion.] . . . On retracting the wound-edges we expose the tendon at its insertion into the base of the first metatarsal and the adjacent internal cuneiform bone (Fig. 64, *4*, *A*). Our plan is to sever the tendon, withdraw its proximal end through a vertical incision three inches higher up, draw it downward and outward subcutaneously through a tunnel between the deep fascia and the annular ligament, and anchor it to the cuboid by drilling a hole through that bone opposite the attachment of the cubometatarsal ligament, passing the end of the tendon through the hole and looping it around the ligament (Fig. 64, *4*, *5*, *6*). . . .

We have finally overcome, in succession, the equinus, the cavus, and the varus deformities; the patient's foot now meets the table practically flat and slightly abducted—and our operative work is at an end. [Closes incisions without inserting drainage.]

The foot will be encased in gypsum for eight weeks: upon removal of the case a brace will be applied and massage instituted.

Postscript (*December 21, 1915*).—There was primary union of the wound and the case progressed favorably when the patient left the hospital for his home.

DOUBLE CONGENITAL TALIPES EQUINO-VARUS—OPERATIVE CORRECTION

Summary: Clinical history of patient; comments—Whitman's club-foot statistics; importance of early operation for club-foot; operation—plantar fasciotomy; syndesmotomy of calcaneocuboid ligament; tenotomy with elongation of tendo Achillis; transference of tendons of peroneus longus and tibialis anticus; post-operative comments—outline of operative steps for correction of club-foot; danger of gangrene of foot from obliteration of posterior tibial artery; operation upon opposite foot.

CLINICAL HISTORY OF PATIENT

A MALE, fourteen years of age, was admitted to Mercy Hospital November 15, 1915.

When the patient was born,—the labor being at full term and uncomplicated,—it was noticed that both feet were inverted.

When the patient was three months of age both Achilles tendons were tenotomized and elongated: after the operations both feet were immobilized by plaster-of-Paris dressings for one year.

Additional corrective operations—the nature of which is not stated—were performed upon the feet at the ages of eighteen months and three years: in both instances the members were immobilized for three months, and after the second operative séance braces were applied and retained for one year.

COMMENTS

DR. MURPHY (November 23, 1915): This patient is afflicted with double congenital club-foot. According to Whitman's statistics of 4718 cases of club-foot, more than 50 per cent. were congenital: of these, 1355 occurred in males and 748 in females; and 77.4 per cent. were of the type exhibited by our patient today, while the remaining 22.6 per cent. represented all the other varieties combined.

The acquired club-foot, which occurred in less than 50 per cent. of Whitman's series, involved males and females about equally: the cause of this variety is almost always anterior poliomyelitis.

The tragedy of club-foot is that it should be neglected by making no attempts to remedy the deformity in early infancy, when good results are obtainable; for when corrected later in life, the deformed conformation persists despite operation, although the foot can be made to come flat upon the ground and be "serviceably sound." *Redressement* accomplishes a great deal —even total correction—in early infancy: it is futile in adolescents and adults.

OPERATION

The inner portion of the plantar fascia is contracted: it represents the string of the bow, which is the arched foot, and must be divided as our first step today subcutaneously just anterior to the tuberosity of the os calcis. [Performs plantar fasciotomy (*vide* Fig. 63, *3*, p. 342).] . . .

The next step consists of dividing the contracted inferior calcaneocuboid ligament, the normal action of which is to limit extension at Chopart's joint, and which, when contracted, gives rise to a deformed arching of the foot termed *talipes plantaris:* it lies deep to the plantar fascia, pursues the same direction, and has the same action when contracted. [Severs the ligament opposite middle of outer portion of under surface of os calcis.] . . .

So far we have released the constricting bands in the foot proper; without any further measures the foot *looks* to be in good shape, but there is still work to be done upon the tendons of the leg. The tendo Achillis, for example, must be elongated, and offers difficulties in that it was divided once before. [Tendo Achillis severed and elongated (*vide* p. 335, and Fig. 63, *1*, *2*).] . . .

Now you can see, from the improved position of the foot after division of the tendo Achillis, why we did not rest content with the work upon the contracted plantar bands alone; nor can we stop at this juncture: the *cavus* has been overcome, and the *equinus*, but the *varus* deformity is still operative, and to overcome it attention must be directed toward strengthening the *evertor* mechanism of the foot by transferring to its outer border the tendons which are most suitable for the purpose, and which in this case are those of the tibialis anticus and the peroneus longus muscles. [Releases first the peroneus longus tendon and transfers it subcutaneously from behind to before the fibular malleolus, finally anchoring it to base of fifth metatarsal bone; secondly, transfers to same point two-thirds of tendon of tibialis anticus.] . . . It remains to elongate the flexors of the toes, to prevent the patient's walking upon the tips of the digits: we shall attend to this in the near future. [Closes incision without inserting drainage, and applies fixation-dressing with foot in position of slight overcorrection.]

POSTOPERATIVE COMMENTS

It is apparent that the operative correction of club-foot is a fairly extensive procedure: it requires overcoming of *cavus* (plantar fasciotomy and syndesmotomy); of *equinus* (Achilles tenotomy with lengthening); of *varus* (transference of tendon of tibialis anticus, with or without peroneus longus to outer border of foot); of *flexion-contracture* of toes (elongation of digital flexors); and, in addition, occasional resection of the tarsus. However perfectly the operation may be executed, there is the constant danger of narrowing or obliterating the lumen of the posterior tibial artery from overstretching of the foot, so that all the painstaking operative work may be undone from the necessity of relaxing the foot to avoid gangrene: the same danger attends the reduction of Pott's fracture (vol. iv, October, 1915, 1022).

N. B.—The left foot was operated upon in a similar manner on December 23, 1915: it was also necessary to resect the major portion of the neck of the astragalus and a portion of the cuboid. On January 19, 1916,—four weeks later,—the flexor tendons of the toes were elongated.

Postscript (February 15, 1916).—The patient made an uneventful recovery. When he left hospital, three days ago, he was able to place both feet flat upon the ground.

ANCIENT POTT'S FRACTURE—OPERATIVE REDUCTION—NAILING OF MALLEOLI

Summary: Clinical history of patient; comments—mechanism of the injury; method of reduction; length of time to immobilize fragments; management of ancient *vs.* recent cases; proper time for performance of operation; operation —malleoli released and nailed to tibia; postoperative comments—position in which to dress foot; regard for circulation in toes important.

CLINICAL HISTORY OF PATIENT

A FEMALE, fifty-five years of age, was admitted to Mercy Hospital September 15, 1915. The family history revealed that the patient's mother suffered from pulmonary tuberculosis.

Three months previously, on June 21, 1915, the patient fell off a ladder a distance of three feet, the entire weight of her body coming down upon her left leg. Immediately after the accident the patient noticed that the foot was turned outward until the inner border rested upon the ground. There was severe pain. A physician reduced the deformity and applied a splint to the ankle. At the end of three weeks the splint was removed; an abrasion was found just above the tibial malleolus, and the latter was exposed to view. The foot and leg were encased in plaster-of-Paris, a fenestration being provided opposite the tibial malleolus for dressing purposes.

The malleolar ulcer continued discharging for the next five weeks. The plaster case was retained four weeks, and after it was removed the patient got about on crutches, and has not been able to discard them. The ankle is painful, especially on motion. Motion in the ankle-joint is limited, and the patient cannot bear weight upon the injured member.

Examination by Dr. Murphy.—The united fibular fragments form an obtuse angle, the upper end of the lower fragment being lodged over against the periosteum of the tibia: the malleolus, however, preserves its normal relationship to the astragalus.

The tibial malleolus is displaced outward as far as a plumb-line let drop through the center of the anterior surface of the tibia. The foot is subluxated posteriorly and cannot be brought to a right angle with the tibia.

COMMENTS

Dr. Murphy (September 16, 1915): Of all fractures with which we have to deal by operation, these ancient Pott's fractures are the most disagreeable, and their reduction tries one's patience severely.

The mechanism of Pott's fracture consists first in forcible eversion of the foot until the outer surface of the astragalus is driven against the fibular malleolus; secondly, in fracture of the shaft of the fibula, usually above the inferior tibiofibular joint, the unyielding interosseous ligament acting as a fulcrum; thirdly, by continuation of the vulnerating force, the acute supero-external border of the astragalus develops as a wedge and is driven upward between the tibia and the fibula until it springs the joint by lacerating the interosseous ligament. Pott's fracture is never produced by *in*version-mechanism.

Posterior subluxation of the astragalus with the foot should be suspected when it is impossible to extend the foot passively to less than a right angle with the leg, motion in this direction being interfered with by the anterior portion of the astragalus impinging upon the anterior margin of the lower end of the tibia: reduction, therefore, cannot be effected by working in this direction.

In effecting reduction, the first step consists of plantar hyperextension of the foot, making a skid of the articular surface of the astragalus, and then dragging the foot downward, gradually extending until the foot forms a right angle or less with the leg. After having reduced the posterior subluxation, the next step is to invert the foot as far as it will go. If the fracture is above the tibiofibular mortise, the foot is dressed in the position in which it is left after reduction, namely, in hyperextension and adduction.

In order to obtain a good result after reduction the foot is immobilized six weeks, and the patient is forbidden to put his weight upon it for another four weeks, making ten weeks in all. Why so long? Although by the end of six weeks the fragments will have become united, yet the interosseous ligament requires a longer period for union; and if weight be borne upon the foot before the ligament is sound, the latter will slowly yield, allowing eversion of the foot until eventually the patient walks upon the tibial malleolus.

This is an ancient fracture—it occurred three months ago. In all probability the tibiofibular mortise is filled in with new bone, which must be removed before the subluxation can be reduced. The attachment of the upper end of the lower fragment of the fibula to the periosteum of the tibia must also be freed. In order to bring the foot up to a right angle with the leg it is often necessary to use the lever in these old cases. By the time reduction is finally effected, the ankle-joint is very ragged looking, but nevertheless surprisingly good results ensue. However, we never approach these ancient fractures without apprehension, and therefore state the facts plainly to the patient in the presence of the stenographer, for no one can foretell what the effects of infection would be.

If the fracture is seen ten days after the accident, before union has taken place, manual reduction is effected by the method described above, and the ankle is immobilized in a plaster case. If the reduction is hard to maintain, the fragments may be secured by the extra-articular nailing method (vol. iv, December, 1915, p. 1109). The more I see of these cases, the less inclined I am to perform open operation, owing to bad results that have arisen at the hands of others from infection, the cases coming to us later for correction of very vicious deformities. Asepsis is a *sine qua non* in bone work. That past master in asepsis, Mr. Lane, performs a bone-operation from beginning to end without contacting his fingers with the wound, and without contacting his fingers with the end of the instrument that has contacted with the wound. That is why his results have been exceptionally good.

Of no less importance than asepsis is the *time* when the operation should be performed. An open operation should never be performed before the eighth day from the time of receipt of the injury, but between the eighth and the fifteenth day in adults, by which time the tissues have recuperated and coffer-dammed themselves against infecting microörganisms should they be admitted in considerable number.

OPERATION

[Incision over tibial malleolus.] . . . The tibial malleolus is united by fibrous tissue in vicious position. [With artist's chisel frees tibial malleolus from its union with the lower articular surface of the tibia.] . . . The next step consists in removing the callus that has formed in the inferior tibiofibular articulation, so as to release the fibular malleolus from its fibrous attachment to the site of the lacerated interosseous ligament. [Forcibly displaces fibular malleolus to its normal position.] . . . The fibular union was not firm enough to require the use of the chisel. [Drives retaining nail through each malleolus in turn into tibia.] . . . The foot is now quite straight and secured by a nail. I am now reconstructing the soft parts: an element of danger lurked about the tibial malleolus in the presence of the old sinus-scar, which was adherent to the bone; and unless accurate apposition of the skin-edges be effected, saprophytes might enter between them and attack the bone. As an extra precaution we apply the old-fashioned 5 per cent. moist gauze dressing to destroy the saprophytes which might work their way from the surrounding skin beneath the dressing to the wound. The foot is now hyperextended and superlatively adducted, and secured in that position by plaster-of-Paris, which will be retained for from three to four weeks, or until firm callus has had time to develop.

POSTOPERATIVE COMMENTS

Primarily all cases of Pott's fracture should be dressed in the position of hyperextension with superlative adduction (the equinovarus position). The work of releasing the fragments was rendered much easier by the absence of bony union. We inserted two nails to prevent the malleoli from slipping out of position to one or other side: without an external support in addition, however, the nails might bend from the enormous leverage to which they will be subjected, and the displacement might recur.

To relieve the tension upon the tendo Achillis and allow the foot to be hyperextended we flex the knee-joint, relaxing the gastrocnemius muscle.

The plaster case is cut with the Gigli saw before the patient leaves the room: we never apply a circular plaster case without cutting it immediately.

Let the record show that the circulation in the toes is good.

Why do I make that statement in the record? It is because in one case, after bringing the foot into the position of hyperextension, the resulting tension on the posterior tibial artery was so great that the hallux became gangrenous and had to be removed. I state that the circulation in the foot is good at this time: should venous stasis arise later, I would know when it had happened, *i. e.*, as a secondary, arterial obliteration and not as a primary injury to the vein.

Postscript.—There was primary union of both skin and bone. The result was satisfactory.

ANCIENT BIMALLEOLAR INVERSION-FRACTURE—REDUCTION—NAILING

Summary: Clinical history of patient; comments—diagnosis of malleolar fractures —eversion- *vs.* inversion-mechanism; position in which to dress inversion-fracture; operation—tibial malleolus found displaced upward and inward and united by fibrous tissue—fibular malleolus displaced downward and inward and united by bony tissue; preparation of each malleolus for reduction; nailing of each malleolus.

CLINICAL HISTORY OF PATIENT

A FEMALE, sixty years of age, was admitted to Mercy Hospital November 9, 1915.

Nearly eight months ago, on March 20, 1915, the patient stepped on the edge of a drain-hole two feet in diameter and turned the left foot inward. Severe pain ensued, and in trying to recover her balance she fell to the left. While not rendered unconscious, she could not get up without assistance, nor could she put her weight on the left leg: she states that she felt the bones grate. Immediately after the fall the limb began to swell.

Within one hour after the accident the patient was examined by a physician, who told her that both bones of the leg were fractured just above the ankle; and within two hours after the accident a gypsum case was applied.

At the end of three weeks, when the case was removed, the foot was found inverted; and two days later a new gypsum case was applied and retained for eight weeks, and since then the patient has been walking about with the aid of crutches.

COMMENTS

DR. MURPHY (November 13, 1915): The patient seeks relief because she cannot put her weight upon the left foot, since it is turned inward too far. I saw her for only three minutes, and then asked but one question, "How did your foot look after you fell?" She replied, "My foot turned inward until the sole faced the other leg." That is all the information one needs when making a diagnosis, for in any injury to the ankle the burning question always is whether there is fracture by *e*version or *in*version.

This patient suffered an *in*version-injury, as you have already surmised from her statements before seeing the skiagram. The physician treated the injury as a Pott's (*i. e.*, *e*version) fracture, which, however, always results from *e*version-mechanism—never from inversion. If, upon leaving today, you gentlemen will just remember that fact, I do not care if you forget everything else. The physician dressed the leg in the superlative degree of *ad*duction—a plan which is quite proper when dealing with Pott's fractures, but positively wrong in inversion-fractures. This ankle is not the seat of Pott's fracture at all.

This patient cannot put her weight on the leg, nor will she ever be able to walk without an operation.

When dealing with a fracture of both the tibia and fibula of this *in*version-type, you must dress it either straight or in slight *ab*duction, so as to bring the tibial malleolus downward, where it belongs, by relieving the pressure of the astragalus against it.

OPERATION

[Incision made just external to tendon of tibialis anticus.] . . . The tibial malleolar fragment moves, and my scalpel may be passed through the plane of fracture without encountering resistance, thereby demonstrating the absence of bony union and corresponding exactly with the appearance presented by the skiagram (Fig. 65).

I am just freeing that fibrous attachment of the tibial malleolus. . . . Now it is perfectly loose. In order to abduct the foot I must plane its fracture-surfaces down until it is quite smooth. . . .

Now we turn our attention to the fibular malleolus: it is displaced inward and united by bony tissue with the lower articular surface of the tibia (Fig. 65). I must use the astragalus as a guide to insuring the proper angle for the foot. [With chisel frees fibular malleolus.] . . . The fibular malleolus is now over in proper alinement, and I am securing it by a nail, which is driven from below, upward and inward through the malleolus into the tibia (Fig. 66). . . . Now I am inserting a nail through the tibial malleolus from below, upward and outward into the tibia. . . . The foot is at last properly reduced and retained: it is even a little overcorrected. [Closes skin-wound.]

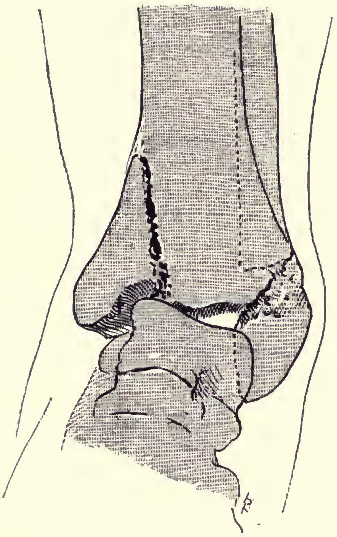

Fig. 65.—Bimalleolar *in*version fracture: tibial malleolus shoved by astragalus inward and upward and united by fibrous tissue; fibular malleolus dragged by untorn external lateral ligament inward and downward and united by bony tissue.

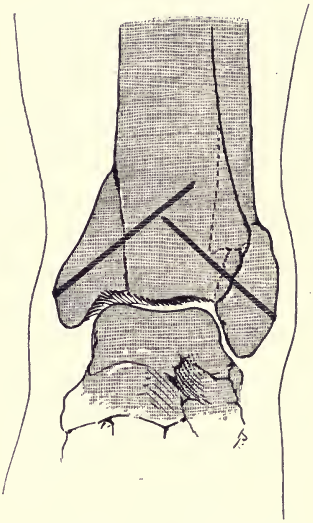

Fig. 66.—Malleoli restored to their normal positions and retained by nails.

RECAPITULATION

Let the record show that we easily exposed the plane of fracture of the tibial malleolus and that there was only fibrous union between it and the adjacent surface of the tibia; that the area of fibrous union was freed, the malleolus separated, and a long, thin, wedge-shaped piece was removed from it down to the level of the articular surface of the tibia, so as to release the foot for abduction; that the fibular malleolus was next exposed, and its plane of bony union to the under surface of the tibia was freed until the foot could be overcorrected in abduction; and finally that nails were driven from below upward through both malleoli into the solid bone of the lower end of the tibia.

Let the record show further that all the work was accomplished without hand-contacting.

Postscript (*December 20, 1915*).—The patient is still in hospital and is making an excellent recovery. The wound healed *per primam.*

[The bibliography of eversion- and inversion-malleolar fractures was published in vol. iv, October, 1915, p. 1025.]

BILATERAL COMPRESSION-FRACTURE OF ASTRAGALUS AND OS CALCIS. RIGHT FOOT—ARTHRODESIS OF ASTRAGALO-SCAPHOID JOINT; BOTH FEET—REMOVAL OF SUBMALLEOLAR CALCANEAN EXOSTOSIS

Summary: Clinical history of patient; comments—annoyance from these injuries; their mechanism; difficulty of surgical treatment—Cotton's method; operation—right foot—depression of arch corrected by arthrodesis; both feet—removal of exostosis from os calcis just below fibular malleolus.

CLINICAL HISTORY OF PATIENT

A MALE, thirty years of age, was admitted to Mercy Hospital November 1, 1915.

Over three months ago, on July 22, 1915, the patient fell 20 feet and landed on the soles of both feet. After the accident, he was unable to walk. Both feet were dressed in the inverted position, and the patient laid up for two months and then began to walk with crutches, and for the last two weeks with the aid of a cane alone. Walking, however, is painful and has become more and more so.

Examination by Dr. Murphy (November 1, 1915).—There is a bilateral fracture of both the astragalus and the os calcis. The right foot is more severely involved than the left.

COMMENTS

DR. MURPHY (November 4, 1915): Fractures of the astragalus and the os calcis—particularly the astragalus—are most liable to be followed by unpleasant and annoying sequelæ. They usually result from falls upon the heel; and the compression-mechanism which is operative causes, in addition to fracture, extra width between the malleoli, flattening of the plantar arch, and pressure of the tip of the fibular malleolus against the periosteum of the outer side of the os calcis, this last giving rise to an annoying burning sensation similar to that from a corn under continuous compression.

These cases are most difficult to handle surgically. One of the best plans to adopt is that which was suggested by Cotton, of Boston. By this plan, when the acute swelling following fracture has subsided,—usually requiring from six to eight days,—the foot, well padded, is placed flat on a block of wood and struck opposite the malleoli with a heavy mallet weighing four pounds; the crushed bones are so shaped that instead of presenting a flat surface, they present a pyramidal surface.

I am sorry that I cannot have this patient *walk* into the clinic to show you the manner in which he walks. Patients suffering from this fracture are always on tension lest they evert the ankle, for eversion causes the malleoli to press on the astragalus, thereby giving rise to much pain and discomfort. After correction of the deformity it is better to dress the foot in the position of talipes equinovarus, because this position steadies the plantar arch. In the opposite position—that of talipes valgus—tension is thrust upon the plantar arch, and the weakening of the arch is liable to result in flat-foot. When the foot is released from the plaster dressing, it will be in the position of talipes equinovarus, and the tendo Achillis will be shortened from contraction: this, however, is not so great a disadvantage as it seems, for the tendon may be elongated subcutaneously by the "*Z*" splitting method (*vide supra*, p. 335).

OPERATION

There is depression of the plantar arch. The tip of the fibular malleolus is pressing against the outer surface of the os calcis. The right foot is not so flat as the left. We must endeavor to correct the deformity, and at the same time to remove that exostosis on the os calcis, pressure upon which causes so much discomfort. The plantar arch must be restored to lessen the tendency to recurrence. [Incision along inner side of right foot.]

Here is a mass of connective tissue, the sequence of the osteoperiostitis. There is the head of the astragalus. [Resects head of this bone.] . . . The scaphoid bone is now well exposed, and I find that I can bring the foot around into better position. I shall remove the cartilage from the posterior articular surface of the scaphoid, so that, with freshened surfaces of both bones, astragaloscaphoid arthrodesis will result and reëstablish the plantar arch.

There is the osteoperiosteal thickening of the outer side of the os calcis, extending away out beyond the surface of the fibular malleolus. There is the tendon of the peroneus longus shining beneath the peroneal tubercle. The result will not be good if I let that projecting subperiosteal exostosis of the os calcis remain, for the tip of the fibular malleolus presses against it and causes discomfort. [Resects projecting ledge from os calcis.] . . .

Turning our attention to the left side, we find exactly the same state of affairs on the os calcis—the ledge on this side extending ⅓ of an inch beyond the level of the tip of the fibular malleolus. So, too, the astragalus is flattened: it is not this bone that is causing the mischief, however, but the os calcis. Owing to the absence of eversion in this foot the astragalus will not have to be resected, nor the cartilage on the scaphoid removed, as in the case of the right foot; but we must remove the exostosis on the outer side of the os calcis, to prevent discomfort from the pressure of the tip of the fibular malleolus against it.

RECAPITULATION

Let the record show that, on the right side, the head of the astragalus, the cartilage covering the posterior articular surface of the scaphoid, and the exostosis on the outer surface of the os calcis, where the tip of the fibular malleolus was pressing against it, were removed; and that a similar exostosis on the outer surface of the left os calcis was also removed.

Postscript.—The patient made a splendid recovery, and the result was perfect.

ANCIENT FRACTURE OF ASTRAGALUS—ARTHROTOMY OF ANKLE-JOINT FOR RESECTION OF ASTRAGALUS—TENOTOMY OF TENDO ACHILLIS

Summary: Clinical history of patient; comments—nature of injury; a consideration of fractures about the ankle-joint; operation—exposure of ankle-joint and resection of projecting portion of astragalus; tenotomy of tendo Achillis by usual method.

CLINICAL HISTORY OF PATIENT

A MALE, twenty years of age, was admitted to Mercy Hospital September 24, 1915.

Ten months ago, on November 27, 1914, the patient fell 20 feet through a hay-chute, striking on his feet, especially on the left. On looking at his left foot he noticed that it was turned inward. Shortly afterward the foot was encased in plaster-of-Paris at a nearby hospital: the case was retained for three weeks, during which time the patient suffered constantly from pain in the foot. Upon removal of the plaster the foot was found in the position of inversion and flexion. The gypsum case was renewed and retained for one month.

Four months after the accident, under an anesthetic, the inversion was corrected by flexing the foot to a right angle. A gypsum case was applied and retained for three weeks: there was very little pain. When the case was removed, the foot was found to be in the same deformed position as it was previously.

At present the patient suffers pain in the ankle-joint, whether walking or standing, and during extension as well as flexion. There is a sensation of constriction around the ankle, and a click is heard on sudden extension. The motions of eversion and inversion are impossible, while flexion and extension are limited in range.

Examination by Dr. Murphy (September 14, 1915).—There is a fracture of the astragalus with depression of the posterior or principal weight-bearing portion.

COMMENTS

DR. MURPHY (September 27, 1915): In the anteroposterior view the skiagram is deceptive, suggesting a normal, uninjured foot. The lateral view, on the other hand, reveals a plane of fracture through the astragalus, with depression of the posterior half of the bone. Extension of the foot is limited by the upper fragment of the astragalus impinging against the anterior articular margin of the tibia. The foot is subluxated posteriorly. Close study of the skiagram unfolds the whole story.

This case has been treated as one of Pott's fracture, although it was a fracture of the astragalus. The primary management of the case was, of course, difficult, because the only way to effect reduction was by first hyperextending and then straightening it, but even that method would not have been effective. Had the foot been dressed in the position of flexion instead of extension, there would have been a good result, because the fracture would have united below instead of above.

Of fractures occurring near the ankle-joint, the commonest is Pott's: next to Colles's fracture Pott's fracture is most frequently accompanied by vicious deformity. A real Pott's fracture involves the fibula and the articular surface of the tibia and is always an *e*version-fracture. When the patient states that at the time of the accident the foot turned *in*ward, then you know immediately that he has not suffered Pott's fracture. Such information obtained from the history is almost as valuable as that obtained from the skiagram. Pott's fracture is never the sequence of turning the foot inward, but always of turning the foot *out*ward. In extreme cases of Pott's fracture not only are the fibula and the tibial malleolus fractured, but—and of far greater import—the interosseous ligament of the inferior tibiofibular joint is lacerated (see p. 350), and by the following mechanism. When the foot is forcibly *e*verted and the fibular malleolus or shaft above fractured, the supero-external edge of the astragalus is driven as a wedge into the inferior tibiofibular joint and encounters and lacerates the interosseous ligament. In the young and the middle aged the fibula unites in from five and one-half weeks after fracture, but for union of the interosseous ligament to occur requires seven or eight weeks: hence if the immobilizing dressing should be removed in four or five weeks, the interosseous ligament yields to the weight of the body until eventually the patient walks on the tibial malleolus. Some fear ankylosis following prolonged immobilization; but bony ankylosis does not result from such a cause—temporary stiffness alone.

After reduction a simple Pott's fracture without posterior luxation of the foot should be dressed in hyperextension and adduction. If in addition to the fracture there is anterior luxation of the tibia (*i. e.*, posterior luxation of astragalus), the foot cannot be brought into hyperextension, so that this injury may be suspected in advance of the skiagram. Reduction is effected by making a skid of the astragalus (plantar flexion of foot), followed by traction and then dorsal flexion to less than a right angle and retained by a plaster case.

In this case it is evident that the deformity may be overcome by resecting the upper portion of the astragalus or the adjacent portion of the tibia: the latter procedure would result in weakening of the joint. This case is interesting because the fracture is so seldom seen.

OPERATION

This foot is inverted, and there is an obstruction to dorsal extension. From its long period of inactivity in the position of plantar flexion the tendo Achillis has become contracted and must be elongated. [Incision between tibial malleolus and adjacent tendon of tibialis anticus; long saphenous vein encountered and ligated]. . . .

I have now entered the synovial cavity, exposing the articular surfaces to be sure that nothing within the joint is overlooked. There is the articular surface of the astragalus: here is the line of fracture. [With curved chisel resects upper edge of posterior fragment of astragalus.] . . . The ankle-joint is now released from the obstructing fragment, and the foot may be extended despite the contraction of the tendo Achillis. The only freshened joint-surface is on the astragalus: the cartilage covering the tibia has not been disturbed, so that bony ankylosis will not result from the operation, since it requires *two* freshened bony surfaces to result in bony union. [Closes incision in capsule and then superficial fascia and skin, without inserting drainage.] . . .

I never employed that incision before, but it afforded a much easier exposure than I thought it would—just as perfect as the external approach affords.

RECAPITULATION

Let the record show that we exposed the joint from the inner side by entering between the tibial malleolus and the tendon of the tibialis anticus, and by retraction of the soft tissues exposed the astragalus; that next, with the curved chisel, we resected the upper edge of the posterior fragment of the astragalus; and finally that all the work was performed without hand-contacting.

TENOTOMY OF TENDO ACHILLIS

The foot shows a tendency to turn inward too far, and in performing subcutaneous tenotomy, I shall detach the inner half of the tendo Achillis, leaving the outer half attached to the os calcis, so that, after the operation, the foot will tend to turn out. Which half of the tendo Achillis to divide must always be estimated in this manner. [Performs subcutaneous tenotomy of tendo Achillis.] . . . I pass the tenotome through the skin and then direct it upward, piercing the tendo Achillis in its middle and splitting it downward to the os calcis, and then separating the inner half from the os calcis: next we shall divide the outer half higher up, entering the tenotome at the midline again (vol. iii, June, 1914, Figs. 173 and 174, pp. 506 and 507).

Let the record show that the tendo Achillis was elongated in the usual way.

In adults we usually elongate the tendo Achillis by the open operation, but that is not necessary here.

Postscript.—There was primary union and good function resulted.

PERFORATING ULCER OF HEEL—EXCISION OF ULCER

Summary: Clinical history of patient; comments—nature of the lesion; importance of a radical operation; operation—wide excision of ulcer through normal tissue down to bone; tissues coaptated by compression-suture; union of tissues delayed because of trophic disturbances present.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-six years of age, was admitted to Mercy Hospital September 10, 1915. The family and past histories are negative. No history of the venereal diseases was obtainable.

When fourteen years of age the patient accidentally cut his right foot with an ax: the implement passed horizontally through the ankle-joint from behind, dividing the tendo Achillis and the posterior tibial nerve and artery. The wound was immediately sutured and healed without infection occurring; six months later the patient was able to walk about on the foot, although motion was limited to extension and all plantar sensation distal to the level of the wound was lost.

Two years after the accident a blister appeared on the plantar surface of the heel, burst, and discharged a drop or two of thin, blood-stained fluid. The patient bandaged the heel and continued walking upon it, with the result that the ulcer became worse; when the patient took to bed, however, the ulcer healed, but reopened and became larger when walking was resumed. This cycle was repeated many times until finally the ulcer became very large and deep, and the discharge increased in quantity, although it was never profuse and at no time purulent. Each period of healing required from two to four months before the process was completed.

Since the time of the accident a very tender nodule under the skin has been present, just behind the tibial malleolus, and pressure upon it causes excruciating pain. Since three weeks there has been constantly a dull pain in the vicinity of the fibular malleolus.

Examination by Dr. Murphy (*September 2, 1915*).—There is a trophic ulcer on the plantar aspect of the heel, which has perforated the skin and fascias down to the posterior tubercles of the os calcis. There is, in addition, a neuroma involving the posterior tibial nerve as it passes behind the tibial malleolus.

COMMENTS

Dr. Murphy (September 13, 1915): This lesion is classic and corresponds to the *ulcus perforans pedis*, or *mal perforans* of the text-books: while occasionally involving the heel, it appears more frequently in the anterior portion of the sole, usually under the ball of the great toe.

The causal factor which is operative here is unusual. The ax cut through all tissues posterior to the ankle-joint—tendons, nerves, and blood-vessels. The blisters did not appear until two years after the accident, and resulted from the trophic changes through division of the posterior tibial nerve above the site of the ulcer. Many years ago an Irish surgeon suggested that the popliteal nerve be stretched as a curative measure in perforating ulcers of the foot due to obscure causes. In this case, however, the etiology is plainly that of division of the nerve; and since twenty-two years have elapsed from the time of the division and the gap that exists between the ends, it is doubtful whether the trophic axons of the nerve could be restored mechanically by operative measures and whether regeneration would take place.

The margin of the ulcer is hard and callous, and its base is formed by the os calcis, with a bursal development on the os calcis. We shall endeavor to ablate the entire ulcer-base, removing the periosteum and a portion of the underlying bone, in addition to the cicatricial wall of the sinus.

OPERATION

[Elliptic incision through healthy tissue around sinus down to bone.] . . . There is the posterior attachment of the plantar fascia: the fascia extends forward in fan-shaped manner to the phalanges. I wish to keep the incision to the outer side of the cicatricial deposit in the plantar tissues, so as to have normal tissue for approximation after removal. There is a narrow scar below and a large scar above, and it would not avail to suture the edges of the cicatricial tissue. We appose the tissue by putting in three transverse sutures through the whole thickness of the heel and a large strip of gauze under each stitch loop, to give a broad support so as not to interfere with the circulation, for the large, flat surface thereby obtained prevents strangulation of the tissues. [Compression-suture introduced transversely.]

The foot will be dressed in the elevated position for several weeks, until there is organic union clear down to the bone. In the presence of such trophic disturbances it requires a long time for union to take place, so that if the patient should walk about too soon after the operation, a bad result will be obtained.

RECAPITULATION

Let the record show that the sinus extended in depth to the posterior tubercles of the os calcis; that the involved tissues beneath the os calcis to a depth of 1½ inches were removed, and the surface was flattened out; that all calloused tissue was removed, and a compression-suture introduced transversely to aid in obtaining firm union of the plantar tissues, which is so essential; and finally that two strips of gauze were introduced into the wound.

This compression-stitch will be retained until we feel sure that organic union has occurred, for the tissue is defective trophically and always will remain so.

ADDENDUM *IN RE* VILLOUS SYNOVITIS

Addendum (February 21, 1916).—Many readers of the Clinics will be interested in the note received today from the patient upon whom synovial capsulectomy was performed for hypertrophic villous synovitis of the knee-joint, the extensive pathology of which was illustrated in tints *ad naturam* in the last number (vol. v, February, 1916, facing p. 166).

We shall reprint the postscript of January 4, 1916—six weeks after operation: "There was complete primary union. Already there is a considerable degree of flexion. There is no pain, and the patient is able to bear the full weight upon the leg."

The note is dated seven weeks later, therefore giving the condition of the knee over three months after operation: "I have no pain in my knee, nor any of the old trouble. I can bend it as much as I could before the operation, and the range of motion is gradually increasing. I feel sure that when the swelling and soreness have entirely subsided, I shall have fairly good action."

TALK BY DR. R. C. COFFEY ON CERTAIN ABDOMINAL OPERATIONS

Dr. Murphy (February 5, 1916): I have the pleasure of presenting to you Dr. R. C. Coffey, of Portland, Oregon, who will address you.

Dr. Coffey: Gentlemen: I was greatly interested in Dr. Murphy's Kraske operation for the removal of the rectum. I asked him the question as to whether he thought he was reducing the mortality as much as half by performing the operation in two stages. He said he thought that he was. The statistics of all surgeons who have tried the two-sitting operation in cancer of the rectum show that the danger is even less than half where the operation is done in two stages. The greatest strides that have been made in gastrointestinal surgery are found in the performance of certain operations in two sittings. During the last two or three years we have been performing stomach resections for pyloric cancer in two sittings and think our mortality has been cut in two in exactly the same way as in resection for rectal cancer. We have performed a number of resections of the stomach for ulcer according to the Rodman technic. Occasionally we perform the von Eiselsberg operation, making a unilateral exclusion. The mortality following these operations is certainly two or three times that of gastroenterostomy alone. During the last two or three years we have performed gastroenterostomy at the first operation, and from two weeks to several months later carried out resection of the pylorus. In this way we have cut the mortality of resection of the stomach down to practically that for gastroenterostomy alone, for we have not had a single death as a result of the second, or removal, operation. The same is true of our cancer work. We now never remove a cancer of the pylorus in less than two sittings. At the first operation gastroenteros-

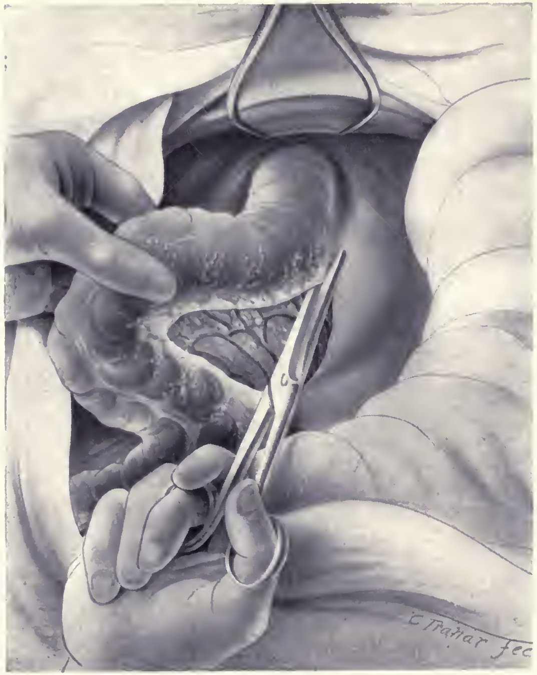

Fig. 67.—The sigmoid is mobilized by cutting the peritoneum on each side of its mesentery (Coffey, in *Annals of Surgery*).

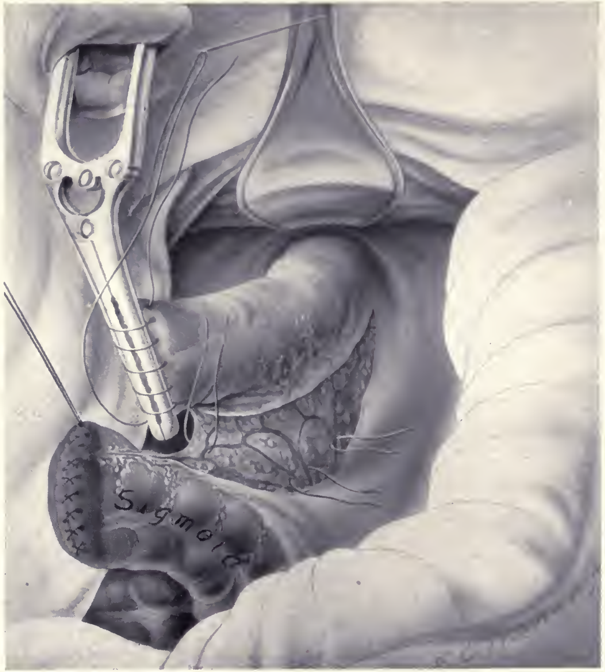

Fig. 68.—The sigmoid is cut between angiotribe forceps with a cautery, and the forceps heated sufficiently to sterilize the ends. Ends are closed and painted with tincture of iodin and mesenteric vessels tied (Coffey, in *Annals of Surgery*).

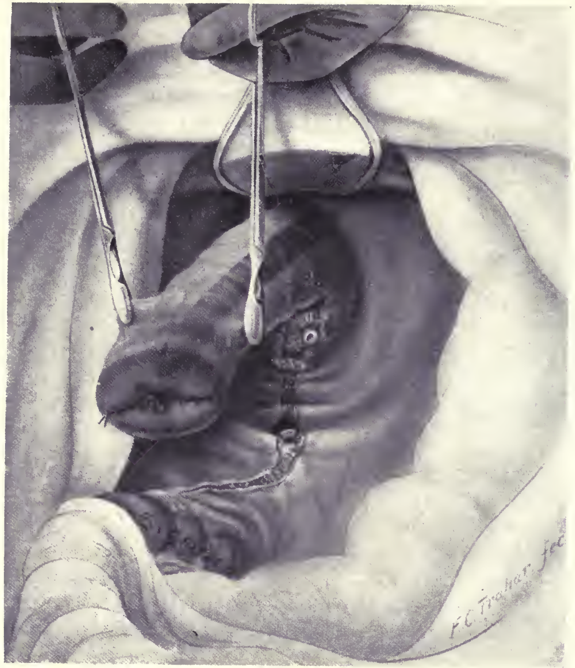

Fig. 69.—Proximal sigmoid wrapped in gauze. Tube is passed up to end of distal sigmoid, where it is fastened by a strong double suture passed through the intestine and eyes of tube and tied. When the intestine is held by two forceps and traction is made on the tube, inversion is produced. Note the ends of the severed superior hemorrhoidal artery (Coffey, in *Annals of Surgery*).

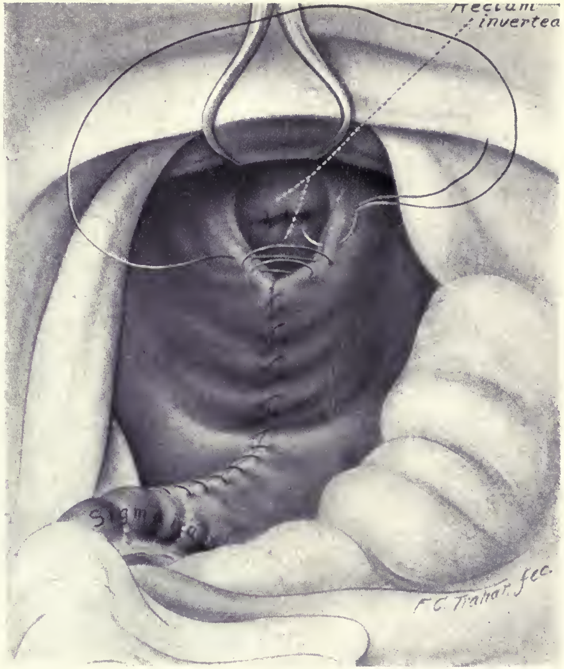

Fig. 70.—After the distal sigmoid has been inverted and drawn out through the anus the inverted end is closed by three or four interrupted catgut sutures, and a continuous catgut suture is run along the mesosigmoid, covering the raw fat edges with peritoneum from the proximal sigmoid to the bottom of the culdesac (Coffey, in *Annals of Surgery*).

tomy—preferably posterior, but sometimes anterior, if more convenient—is performed. The second operation accomplishes the removal of the pylorus with the growth.

We have all noticed cases in which acute abdominal obstruction was due to adhesions. Your patient is vomiting fecal matter and you think that he is in a very bad way. On operating you find an extensive mass of adhesions: if you attempt to break up these adhesions and open up raw spaces, taking a great deal of time, and possibly stripping off the peritoneum with the outer coats of the intestine, you are exposing your patient to great danger. Now if you see the intestine distended above the mass of adhesions and collapsed below, all that is needed is conservative surgery. Simply make a rapid anastomosis between the

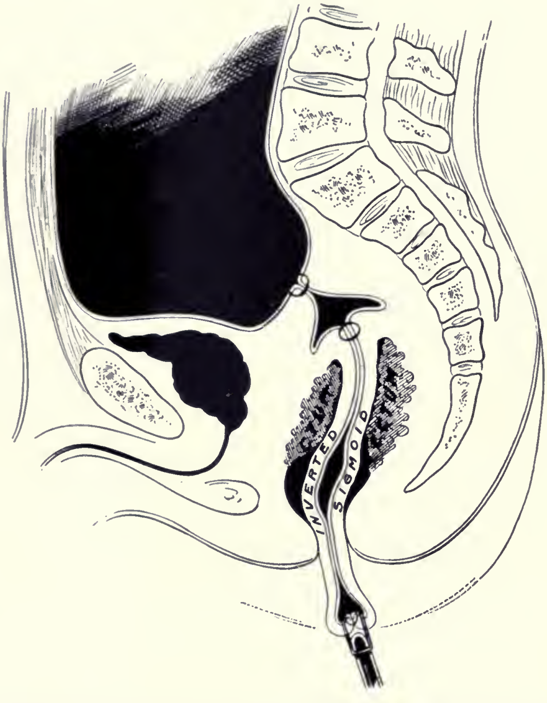

Fig. 71.—Sectional view of sigmoid inverted and drawn out through the anus. Also the peritoneum sutured over end of inverted gut (Coffey, in *Annals of Surgery*).

distended and collapsed loops, with either the Murphy button or a suture: this can easily be extended in fifteen minutes, and in at least nine cases out of ten the final results will be just as good as though the adhesions had been separated, and the mortality will be less than half.

In cancer of the rectum—cases of which Dr. Murphy has shown here today—we now always operate in two sittings by a method we described in the *Annals of Surgery* for April, 1915 (see Figs. 67–71). We have met with more success by this technic than by any other. In my opinion the popularizing of the two-stage gastrointestinal operation is the greatest advance that has been made of late in abdominal surgery.

Dr. Murphy: I am happy to hear Dr. Coffey talk on these subjects, for he has done so much work in the abdomen that we are very much interested in his opinion.

(See article by Lilienthal: "The Two-Stage Principle in Operative Surgery," in *Annals of Surgery*, 1910, li, 30–39.)

MULTIPLE SARCOMATA OF SKIN

Summary: Clinical history of patient; comments—differential diagnosis from von Recklinghausen's disease; operation—ablation of a tumor for microscopic examination; postoperative comments—arsenic therapeusis; spontaneous disappearance; spontaneous disappearance from intercurrent exanthemata; Kaposi's disease; carcinomatosis cutis; differential diagnosis from mycosis fungoides; metastatic cutaneous sarcomatous growths—their importance in the diagnosis of deep-seated primary sarcomata.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-seven years of age, was admitted to Mercy Hospital September 15, 1915. The family and the personal histories are negative.

Nine years previously, in 1906, a few papules appeared on the patient's forehead and chest, increased in number, and spread until at present almost the entire body is covered by them: they are most abundant on the torso (Figs. 72, 73, 74). The papules vary in size from the head of a pin to a hazelnut; are elevated, pink, and contain a clear, watery fluid; are hard to the feel, and do not disappear or alter their shape or size; their edges are sharply defined; they give rise to itching when the patient sweats.

Microscopic examination of one of the excised tumors at the office revealed sarcoma.

COMMENTS

DR. MURPHY (September 18, 1915): At first glance these cutaneous tumors suggest multiple fibroma molluscum (*von Recklinghausen's disease*), which consists of multiple neuromata associated with cutaneous fibromata: these are nerve-sheath tumors, are small, rarely painful, seldom tender, and as a rule remain benign; nerve-elements are seen microscopically with the aid of special silver stains. There is a malady termed *fibroma molluscum gravidarum* which develops during the latter half of pregnancy, and is characterized by multiple fibromyxomatous cutaneous tumors of the cervical and pectoral regions: these tumors disappear spontaneously within six months after parturition; they do not contain nerve-fibers, but are edematous fibroids, and resemble molluscum contagiosa more than von Recklinghausen's disease.

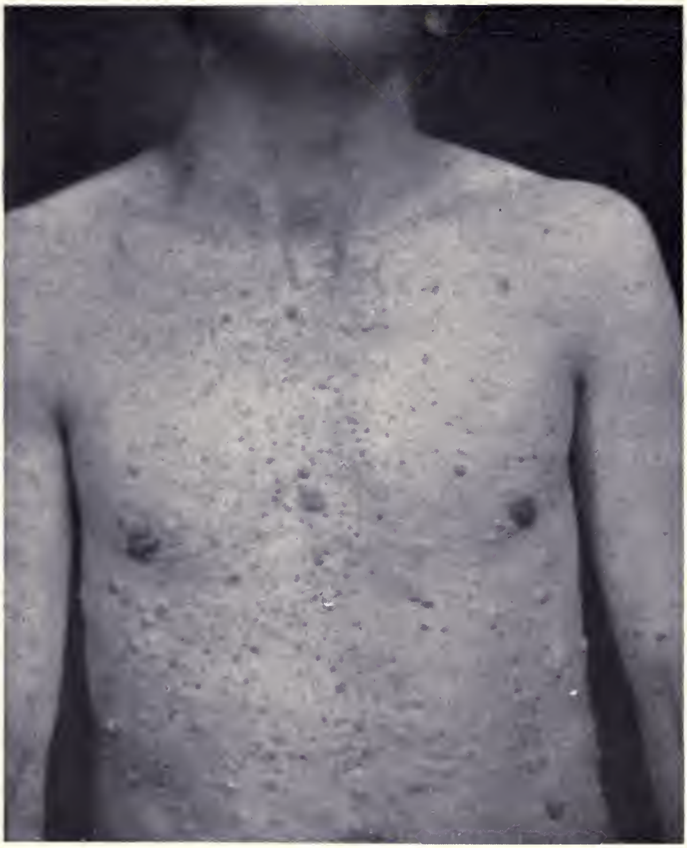

Fig. 72.—Multiple sarcomata of skin.

The pathologist diagnosed spindle-cell sarcoma from a microscopic specimen: this type signifies a mesoblastic tumor whose cells are atypical and one which should terminate fatally. This diagnosis ran counter to ours of fibroma molluscum, and I have grave fears that the pathologist's opinion is correct, for sarcoma bodes ill for the patient. The tumors of fibroma molluscum, however, may remain innocent indefinitely unless from trauma one of them should become viciously malignant. We shall remove one of the tumors from another position to see if, upon microscopic examination, it should prove, after all, to be a fibroma molluscum.

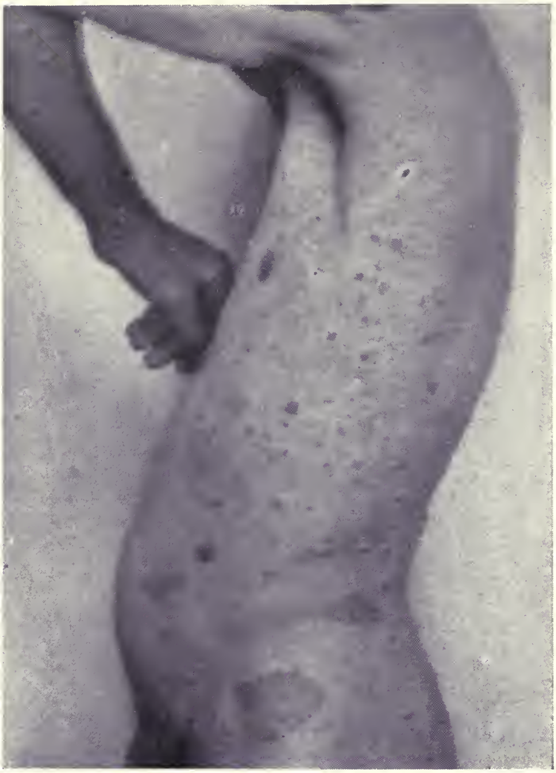

Fig. 73.—Multiple sarcomata of skin.

OPERATION

[Exposes one of the growths through an incision.] . . . Note how cleancut and encapsulated the tumor is. [Ablates tumor.] . . . See how nicely it shells out—quite independently of the neighboring tissues except the vessels. [Closes wound with a stitch.]

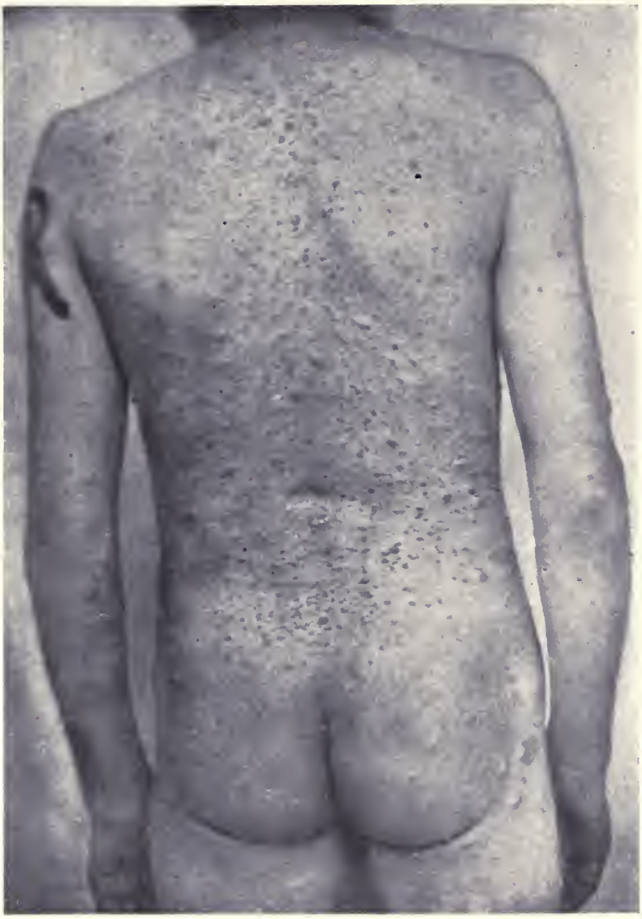

Fig. 74.—Multiple sarcomata of skin.

POSTOPERATIVE COMMENTS

If the pathologist's diagnosis of spindle-cell sarcoma is correct, we have little if any hope for our patient, unless cure should be effected, as sometimes happens, through colossal doses of arsenic, administered both subcutaneously and by injections directly into each tumor. Much more could be expected of arsenic, however, in the cure of sarcomata of the lymphoid type. In giving arsenic in such colossal doses one must beware of hemorrhagic nephritis. In rare instances the tumors of cutaneous sarcoma disappear spontaneously, but one has no means whatever of anticipating such a desirable result. The spontaneous disappearance of certain tumors from intercurrent exanthemata, too, must not be overlooked: thus, Fischer (*Deutsche Ztschr. f. Chir.*, xii, 60) noticed the disappearance or minifying of *sarcoma*, adenoma, and lymph-node tumors from the intercurrence of scarlatina and typhoid fever, while fibroma, lipoma, chondroma, osteoma, and carcinoma remained unaltered; he also saw struma disappear especially rapidly in cholera. The *modus operandi* of Coley's fluid must rest upon similar biologic grounds.

In his original paper, entitled "Ueber einen Fall von sogenannter Sarcomatosis cutis," Kaposi (Bruns, *Beiträge zur klin. Chirurg.*, 1899, xxiv, 526–534) defines the disease which bears his name as follows: "Beginning in the subcutis (as the histologic picture showed, and as we could recognize in the nodules arising *de novo* under our eyes) were painless, brownish-red tumors at first the size of a pea, then growing to the size of a nut, even forming elevated, hemispheric plaques the size of the palm of the hand, and shaped like a flat cake. The disease runs a chronic course, and the internal organs are almost always free."

One cannot help being reminded of the benignity of the carcinomatosis cutis of industrial workers—notably the cutaneous cancer of paraffin workers.

Melanotic sarcomata of the skin at times occur and form virulent metastases throughout the body, especially after trauma, accidental or operative.

The tumors of mycosis fungoides are liable to be mistaken for sarcoma, as they also develop from red, uneven spots, and form granulation-tumors of a brownish-red color which, in the later stages, tend to ulceration and cachexia; but mycosis fungoides is of much slower growth than sarcoma. Syphilitic and tuberculous granulomata can hardly be confounded with sarcoma on careful examination.

Primary multiple sarcomata must not be confounded with secondary sarcomatous growths in connection with a primary cutaneous sarcoma, or a sarcoma of the internal organs. Thus I removed a wen-like mass from a patient's scalp which, upon examination, proved to be a small, round-cell sarcoma, and which was metastatic to the primary sarcoma in the left fibula. (See *The Medical Clinics of Chicago*, March, 1916, 1039–1049.) The importance of searching for and examining such superficial metastatic growths in the diagnosis of deep-seated malignant tumors has been emphasized by Babcock (*New York Medical Journal*, January 18, 1913), who concludes: "Superficial metastases are often absent, but when they are present, it seems to me a waste of scientific energy for those who do not need the experience or mental exercise to spend days and weeks in metabolic tests, repeated physical examinations, and much deductive reasoning, when, almost by a snip of the scissors, a bit of tissue may be secured that may give absolute evidence as to the character of the disease."

Postscript (*February 25, 1916*).—The patient reported today for examination. The tumors are becoming softer, and many are showing the appearance of congenital papillomata: their malignant characteristics are rapidly disappearing. He is to continue the use of sodium cacodylate.

INFECTIVE COSTAL PERICHONDRITIS—RESECTION OF COSTAL CARTILAGES

Summary: Clinical history of patient; comments—types of infection; pathogenesis; operation; postoperative comments—infections due to flora of mouth; cutaneous diphtheria; hyphomycetic infections; sporotrichosis; actinomycosis; blastomycosis.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-three years of age, was admitted to Mercy Hospital February 15, 1916. The family and the past histories are negative. There was no history of typhoid fever.

Nearly two years previously, on April 1, 1914, while in the dental chair, the drill fell out of the operator's hand and wounded the patient over the left fifth rib, three inches from the sternum: the drill was immediately removed.

Three days later the wound swelled and became painful and the patient developed fever.

Five days later (eighth day after injury) the abscess was opened and much pus evacuated: a small rubber drain was inserted. The patient remained in bed for about two weeks, and when he got up and about there was no fever, nor were there any chills.

Three months after the injury, in July, 1914, owing to continuance of the discharge, the left seventh rib was curetted at the costochondral junction: the patient was laid up for one week; there was no fever, nor were there any chills. The operation did not result in checking the discharge.

Eight months after the injury, on December 8, 1914, owing to swelling of the wound and pain in it, as well as the very profuse discharge, the patient went to a hospital and was operated upon on December 18, 1914.

Seven months after the operation, in July, 1915, a tumor about the size of a hen's egg appeared above the ensiform process, and ½ inch to the left: this tumor was incised.

Eleven months after the last operation, in November, 1915, owing to continuance of the discharge, the ensiform process was again curetted: this time the patient was laid up for three weeks, again without fever or chills. The discharge still remained, however. There is marked pain along the left eighth rib for a distance of five inches.

Examination by Dr. Murphy (February 8, 1916).—There is much tenderness over the left fifth rib and its cartilage. While the nature of the tissue-disintegration suggests costal tuberculosis (see vol. iv, August, 1915, 697–698), yet the tuberculin test was negative, and bacteriologic examination of the discharge from the sinus revealed no tubercle bacilli.

COMMENTS

DR. MURPHY (February 17, 1916): This type of infection is usually hematogenous—tuberculous or typhoid. In both instances the infection exhibits a predilection for the perichondrium, and both are obstinate to treatment, particularly the typhoid infection, in which curettage is frequently repeated 8, 10, 12, and even 20 times (see vol. iv, August, 1915, 698). To be effective, operation must be thorough: all involved areas of the cartilage or rib must be exposed, the rib or cartilage resected, and the wound curetted until all the granulation-tissue is removed, and then drained.

The infection in this patient is probably mycelial or bacterial (B. coli) from the mouth: it is a type which we have never seen before. While the cartilage itself resists infection, yet the power of resistance of the perichondrium is but feeble. The infection travels around the cartilage, beneath the perichondrium, elevates the latter, and by thus interfering with the nutrition of the cartilage, causes erosion and even necrosis and sequestrum-formation: the sternum or ribs may also be involved by continuity.

OPERATION

[Through an extensive vest-flap incision the diseased area was exposed and was found to comprise the left seventh and eighth costal cartilages throughout their length: both cartilages were removed *in toto*, exposing the underlying parietal pleura; the sinuses were laid open throughout their length and curetted, and all visible granulation-tissue was removed, even from beneath the ensiform cartilage, although the sterum itself was not involved. The wound was left open and loosely filled with gauze.]

POSTOPERATIVE COMMENTS

In order to accelerate healing we shall order x-rays in therapeutic doses.

It will be noted that these cartilages, while eroded and cloudy in their appearance, did not show the collar-button excavations so commonly associated with typhoid infections of the perichondrium.

In this whole class of cases, a most extensive dissection must be performed, and the cartilage should be removed from its attachment to the sternum, to and including the line of demarcation between the rib and the cartilage, as this is the only hope of preventing recurrence of the infection. This has been accentuated in my recent article, "Bone and Joint Diseases in Relation to Typhoid Fever" (*Trans. Amer. Surg. Assoc.*, 1915, and to appear in *Surg., Gynec. and Obstet.*).

Infections of the soft tissues of the body with the flora of the mouth are characterized by their foulness and often by their virulence. These flora are legion, comprising many varieties of bacteria (Leptothrix buccalis of Robin; fusiform bacillus of Vincent), parasites (spirilla of Vincent; Spirocheta pallida; amebæ), and fungi (molds). Stinking infections of the hand arising from fist-blows upon the teeth—questionably diphtheroid infections—rapidly succumb to the alkalinity which is supplied by sodium bicarbonate dressings. True diphtheria infections of the skin, secondary to faucial, nasal, conjunctival, or vaginal diphtheria, are not common, as shown by the statistics compiled by Filatow from St. Anne's Hospital, Vienna, from 1894 to 1902, where only 23 cases were seen among 2217 diphtheria patients treated. Primary cutaneous diphtheria is still rarer, Billings (*Annals of Surgery*, September, 1915, 343–347) having found but 25 cases in the literature, which, together with his own two cases, total 27.

"Primary cutaneous diphtheria . . . may manifest itself in a single lesion, or in multiple concomitant lesions distributed over a wide area, or in the form of cutaneous and subcutaneous phlegmon, with considerable induration without marked pain, and without fluctuation or suppuration, if not complicated with pyogenic bacteria; and, finally, it may appear in the form of cellulitis with vesiculation resembling erysipelas."

Were our patient suffering from a diphtheria infection we would have applied diphtheria antitoxin directly to the wound, in addition to the usual subcutaneous and intravenous systemic injections.

Of the cutaneous infections due to *hyphomycetes* or molds, those of favus, ringworm, thrush, and tinea versicolor are well known. There are other forms of hyphomycetes which likewise produce chronic superficial cutaneous lesions (kerion), but about which little is known.

Sporotrichosis is another chronic indolent process following upon trauma, which presents some of the characteristics of tuberculosis and of syphilis, but which does not exactly fit into the picture of either. Sporothrix infections were first described by Schenck in 1898 (*Bull. Johns Hopkins Hosp.*, 1898, ix, pp. 286–290), so that recognition of the disease is comparatively recent, and of late case-reports have been rapidly accumulating in the literature. The organism resembles a bush (mycelium) with its leaves (spores). To the branches of the mycelium the pear-shaped spores are attached by very fine pedicles. The spores become readily detached, and are more apt to be found than the mycelia. The organism grows on ordinary media,—especially the sugars,—and stains readily with basic dyes and is Gram-negative: its invasion may be detected by serodiagnosis and by complement-fixation, using the spore-suspension as antigen.

The period of incubation in man averages one week. Suspicion of the disease, aroused by an infection of unusual nature and protracted course, should lead to its detection by laboratory methods. Iodid of sodium is a specific cure for sporotrichosis, and with large doses healing may be complete within a month.

Actinomycosis is another granulomatous-suppurative process of this type, although primary actinomycosis of the outer skin, exclusive of the skin of the face and neck, is not frequently encountered, but when present may, according to Leser (*Archiv. f. klin. Chir.*, 1899, xxxix), appear as a circumscribed ulcerated lesion, or as a nodular formation with central cicatrizations. The subcutaneous tissue may also be affected, and a chronic phlegmonous condition may be produced. The diagnosis is made by examining the characteristic yellow granules from the discharge of the ray fungus, which was first described by Bollinger in June, 1877, as occurring in tumors in animals. In April, 1879, Ponfick recognized the first case in man in the Pathologic Institute at Breslau, and proved beyond question that it was identical with Bollinger's case and also proved that a case observed by James Israel, in 1877, was one of actinomycosis, although not so recognized or classified by Israel. Langenbeck, in 1845, described a similar case, but did not know where to place the disease, and did not show its connection with the lesion in animals. The priority of discovery in animals belongs unquestionably to Bollinger, and its recognition in man to Ponfick in 1879. The first case in the human in America was recognized by John B. Murphy, of Chicago, on June 28, 1884. His article on this subject reporting five cases was published in the *North American Practitioner* in 1891. His original case was demonstrated to the Chicago Medical Society at the time of its recognition.

Blastomycosis is characterized by the formation of multiple minute abscesses in the superficial layers of the skin, and is diagnosed by treating a smear of pus from one of the abscesses with a few drops of a 33 per cent. solution of caustic potash, and examining for the characteristic budding saccharomyces, which were first described by Gilchrist in 1894, and the recognition of which was forced on the profession later by Hyde and Ormsby, of Chicago. Iodid of sodium, together with *x*-rays and local measures, is effective in curing this disease as well as actinomycosis.

Postscript.—The case progressed favorably.

DIVERTICULUM OF ESOPHAGUS—CONSERVATIVE TREATMENT

Summary: Clinical history of patient; comments—the diagnosis, pathology, and treatment of esophageal diverticulum.

CLINICAL HISTORY OF PATIENT

A FEMALE, twenty-eight years of age, was admitted to Mercy Hospital January 28, 1916.

Five weeks previously, on December 25, 1915, the patient noticed difficulty in swallowing solid foods and a gurgling sensation in the throat while eating: she chokes very easily. After having ingested certain fruits—such as apples—at night before retiring, the next morning, after a coughing fit, the fruit was regurgitated unaltered by digestion.

Examination by Dr. Murphy (January 28, 1916).—The passage of esophageal bougies suggests esophageal spasm. A skiagram, taken after an opaque meal, reveals a diverticulum of the esophagus at the level of the seventh cervical vertebra: there is no dilated pocket below (Fig. 75).

COMMENTS

DR. MURPHY (January 29, 1916): This is an interesting case. The patient found it increasingly difficult to swallow. I was unable to pass a fairly large esophageal bougie, nor could the next size be passed down until I changed sides and moved it.

These diverticula are very annoying,—especially when in the thoracic portion of the esophagus (Fig. 76),—though easily handled when accessible. The older operation of ablating the sac and suturing the esophagus with a view to obtaining primary union was fraught with much danger from infection of freshly opened tissues. We have shown in a previous article that it is better, after operative exposure of the diverticulum, not to ablate

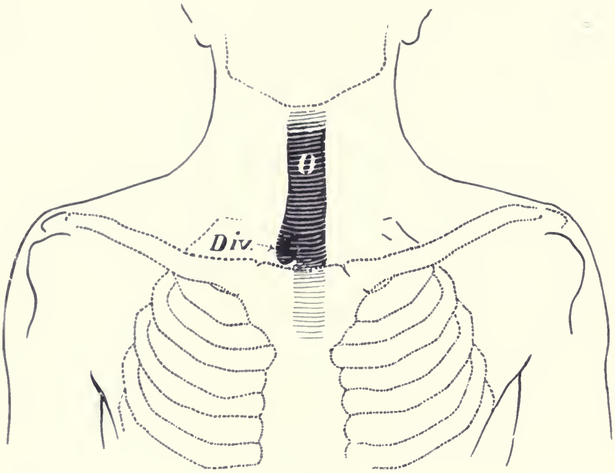

Fig. 75

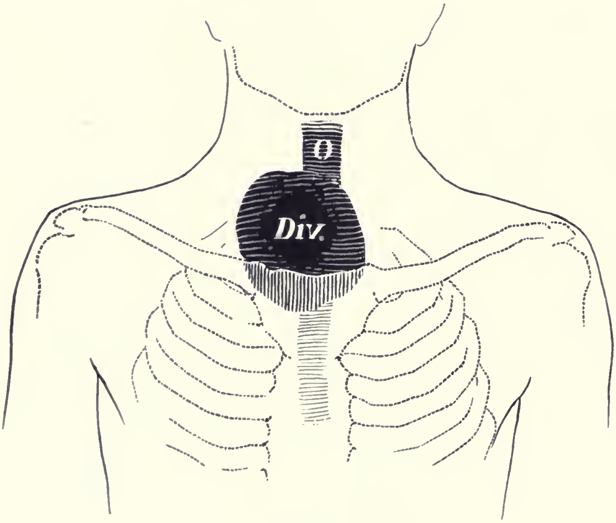

Fig. 76

Figs. 75 and 76.—Sketches of esophageal diverticula interpreted from opaque-meal skiagrams: Fig. 75, Early stage (see text); Fig. 76, moderately large, partly thoracic, but mostly cervical (from another patient).

it immediately, but merely to twist it upon itself and bring it up into the field unopened. After the lapse of sufficient time—twelve to twenty days—to permit of granulation of the operative field and contraction into a firm, cicatricial mass, then, at a second operation, the diverticulum may be safely ablated and the hole in the esophagus closed by suture without the danger of a possibly fatal infective cellulitis ensuing. This is the same principle of coffer-damming which we have applied in the treatment of freshly injured joints; and for the same reason the opening of a colostomy-loop is advantageously postponed for from twenty-four to forty-eight hours.

At present the diverticulum is not serious enough to demand operation, and by having the patient take her nourishment in liquid form, and by cautious dilatation of the esophagus with bougies, the diverticulum will probably contract.

* * * * * * * * * * * * * * * * * * * *

The diagnosis of esophageal diverticulum is established by physical examination if one side of the neck fills up somewhat during swallowing; if a bougie is at one time arrested at a short distance, whereas at another time it passes easily; and if the neck becomes inflated on swallowing, and this swollen portion can be emptied on pressure. Brewer ("Text-Book of Surgery," 1915, 445) considers as a characteristic sign the hourly or half-hourly regurgitation of thick, tenacious mucus. With these signs present an opaque meal is not necessary, but is of confirmatory value.

According to Treves, hernial diverticula of the mucous membrane occasionally occur at the junction of the esophagus and pharynx. They are usually named *pharyngeal pouches*, and protrude between the lower border of the inferior constrictor and commencement of the esophageal musculature, opposite the cricoid cartilage. Since the pouch lies against the spine, it necessarily compresses the commencement of the esophagus when it becomes filled with food (Fig. 77, *Ann. Surg.*, 1910, li, 305). Hertz (*Brit. Med. Jour.*, 1908, i, 132) states that a pouch in this situation may sometimes be identified by *x*-ray examination. Butlin (*Brit. Med. Jour.*, 1898, i, 3) believes that this condition is more frequent than has been supposed, and becomes clinically important, as a rule, in men beyond the age of forty. According to Killian (cited by Jonnesco, in Poirier et Charpy's *Traité d'anatomie humaine*, Paris, 3me éd., 1912, T. 4, f. 1, 200), *globus hystericus* is caused by the spasmodic contraction of the circular fibers at the upper orifice of the esophagus, and is the chief cause of the diverticulum just mentioned. A diverticulum is occasionally found on the ventral wall near the bifurcation of the trachea, and is stated to be due to traction on the gullet consequent upon cicatrization of adhesions to intertracheobronchial lymph-nodes (Todd, "Clinical Anatomy of the Gastro-intestinal Tract," 1915, 51). This *traction-sac* variety of diverticulum forms one of the two classifications described by Rokitansky in 1840: it rarely produces symptoms, however, and is found at necropsy alone. The

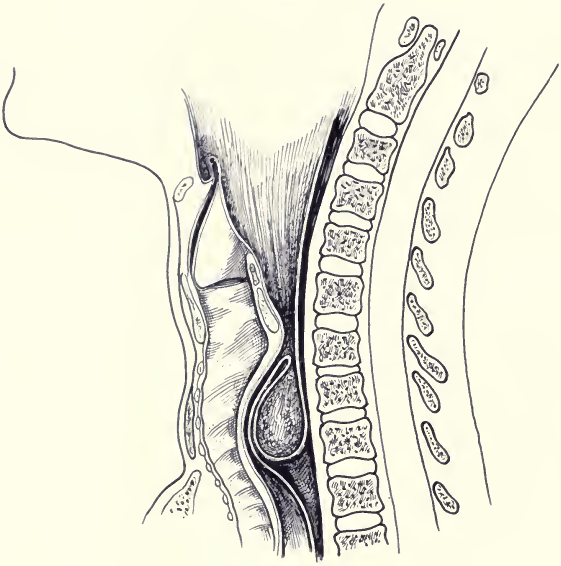

Fig. 77.—Diagram of sagittal section of neck, showing relations of sac to larynx, hypopharynx, esophagus, vertebral column, and sternum, as anticipated from radiographs and found at operation. Note deviation and compression-stricture of esophagus (Stetten, in *Annals of Surgery*).

pressure-sac variety is the common diverticulum, and usually involves the junction of the pharynx with the esophagus—the Lannier-Hackermann area.

The accompanying illustrations (Figs. 78 and 79) show a practical method of physical diagnosis used by H. S. Plummer, and reported in *Annals of Surgery*, 1910, li, 812–817.

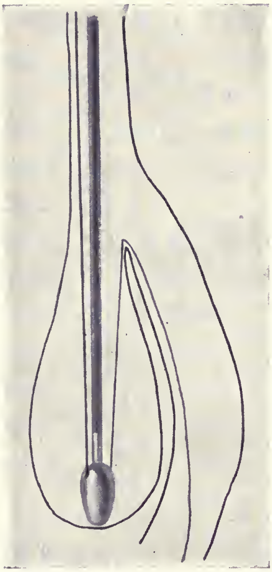

Fig. 78.—Sound pocketed in a diverticulum. Esophageal probe bulb threaded on a swallowed thread passed into the diverticulum (Mayo, "Collected Papers").

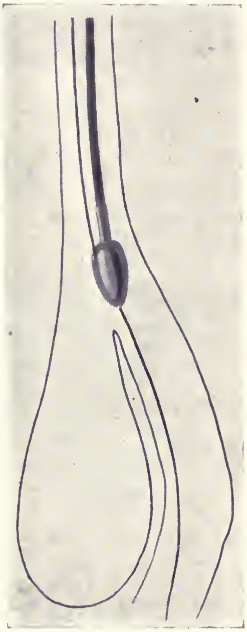

Fig. 79.—Traction on the thread lifting the sound out of the diverticulum. Probe bulb elevated by tightening the thread, showing depth of sac (Mayo, "Collected Papers").

Stetten reviewed the subject of esophageal diverticulum, and gathered a number of operative cases from the literature (*Ann. Surg.*, 1910, li, 300–319): of the total of 60 cases which had been operated upon by various radical methods, 50 were cured and 10 died—a mortality of 16.6 per cent. Primary union of the esophageal wound was obtained in 21 of the 50 cases.

ACUTE CALCULOUS CHOLECYSTITIS—ACUTE PANCREATITIS—CHOLECYSTOSTOMY

Summary: Clinical history of patient; comments—discussion of differential diagnosis; operation—fat-necrosis, induration of pancreas, stone impacted in cystic duct; cholecystostomy; the intense pain of acute pancreatitis; value of gall-bladder in draining pancreas and liver; postoperative comments—review of certain features of case.

CLINICAL HISTORY OF PATIENT

A FEMALE, forty years of age, was admitted to Mercy Hospital December 9, 1915. The family and past histories are negative.

The history of the present illness covers a period of five and one-half years. The first attack was in June, 1910, when the patient suffered from a sharp pain in the upper abdomen, on the right side, just beneath the ribs: there were no chills, nor was there fever, nausea, vomiting, or jaundice; the duration of the attack was ten minutes. These attacks recurred at intervals of three or four months for the next two or three years.

The pain has gradually increased in severity, and during the past year the patient has been doubled up from the pain. It has always been sharp and shooting—never cramp-like; it radiates around to the back and right side. During two attacks the patient vomited bile with relief: she has never vomited blood, nor passed blood in the stool.

Three weeks previous to admission the patient had an attack of pain in the right side, which was so severe as to double her up, but she was not given a hypodermic for the pain. There were no chills, nor was there nausea, vomiting, or jaundice, but the patient states that she felt very hot throughout her body.

Three days before admission the pain recurred, and again the day before admission. At present the patient is very tender throughout the right hypochondrium, and especially sensitive to perpendicular finger-percussion over the gall-bladder.

COMMENTS

Dr. Murphy (December 16, 1915): The patient's leukocyte count one week ago, at the time of admission to hospital, was 18,600. This leukocytosis showed the presence of infection. Arranged in their order of frequency, the upper abdominal lesions which give a similar train of symptoms are, first, gastric ulcer; secondly, duodenal ulcer; thirdly, pancreatic disease; fourthly, gall-bladder disease. [Refers to the cases of cholecystitis associated with pancreatitis which are described below, pp. 401 and 413.] This patient before us is not jaundiced. She is sensitive in the upper abdomen and very fat, so that we are unable to outline the pancreas, although in both the other cases we could clearly outline the organ. This patient's history does not reveal the characteristic story of a gall-stone moving in a duct and giving rise to colic and jaundice, but of an infection of the gall-bladder. In 98 per cent. of the diagnosed infections in the gall-bladder stones are present, according to our statistics up to the present time, but our statistics are going to be rapidly at fault, because we have only been including the cases of acute and chronic calculous cholecystitis which are associated with colic, while we should include that vastly greater number of cases of infections of the gall-bladder associated with great sensitiveness to perpendicular percussion, sensitiveness to hooked finger palpation, with fever and leukocytosis, which heretofore have not been diagnosed as cholecystic infections, but as biliousness, gastritis, etc. The time when the diagnosis of cholelithiasis should be confined to cases with colic and jaundice alone is fortunately now past.

Thus, a patient with a gall-baldder "soreness" and pain of twenty-three years' duration never had colic or jaundice, but at operation her gall-baldder was found filled with stones, some of which were impacted in the mucosa, requiring cholecystectomy in order to remove them. The gall-bladder was a white, cicatricial mass and contained pus as well. There was typical metastatic arthritis from the infection of the gall-bladder, this case being a good example of joint-infection secondary to cholecystitis as a primary source.

OPERATION

This patient is a very large woman, and therefore not a very good operative risk: note how close the costal margin is to the navel! [Vertical incision made through outer portion of right rectus muscle, between ensiform and navel.] . . . As I retract the edges of the wound the first things I see are small plaques of fat-necrosis due to enzymes released from involvement of the pancreas. The gall-bladder is white and filled with stones. [Walls off operative field with gauze pads.] . . . Now I have this field coffer-dammed and am ready to aspirate the gall-bladder. . . . The bile is glycerin-like and inspissated. I can feel a large stone occluding the neck of the gall-bladder and maintaining the hydrops. [Applies purse-string sutures, incises fundus, removes one large calculus and a number of smaller cholesterin calculi, and performs cholecystostomy as described below (p. 405), inserting a hemostatic stitch, maintaining the entropion, and making the gall-bladder mechanically a part of the tube which drains it.] . . .

The entire pancreas is swollen and indurated. The pancreatic enzymes have escaped through the capsule into the peritoneal cavity, producing fat-necrosis, which resembles miliary tuberculosis at first glance. The fat-necrosis accounts for the intense pain the patient had clear across the abdomen. In contrast to colic, intense pain is characteristic of acute pancreatic lesions: no upper abdominal lesion gives rise to such severe pain as fat-necrosis of the pancreas. In the presence of acute pancreatitis the gall-bladder is never removed, because of its value as a means by which to drain not only the pancreas, but also the liver. The omentum, the mesocolon, and the retroperitoneal sac all show pronounced fatty necrosis. [Removes and accounts for gauze sponges and instruments and closes abdominal incision with usual figure-of-8 sutures of silkworm-gut and horsehair, allowing room for exit of rubber tube.]

POSTOPERATIVE COMMENTS

This case was an easy one to handle, for we exposed the cystic and common ducts without encountering a single adhesion. Owing to the tension of the distended gall-bladder, we were unable to feel the large calculus until after we had emptied the organ of the viscid, syrupy bile, which was too thick to pass through the aspirating-needle. Before closing the abdomen we made sure that bile was flowing through the drainage-tube.

It is our interpretation that these pancreatic lesions—like gastric and duodenal ulcers—come on from practically the same type of infection and at the same season of the year.

The really valuable feature about this case is that the pathologic findings were in complete accord with the clinical history: the interpretation of the clinical history and physical signs into pathologic entities is the highest attainment in medicine, and the one for which we are constantly striving.

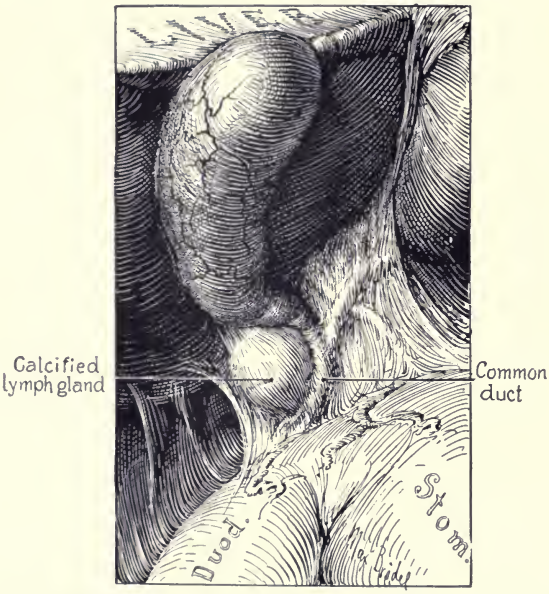

Fig. 80.—A calcified lymph-node embedded in adhesions and lying against the cystic and common bile-ducts (Cullen).

The accompanying picture of a calcified lymph-node (Fig. 80) is instructive, as it shows how such might be mistaken for a calculus of the common duct.

Postscript (*March 2, 1916*).—The drainage-tube was removed February 25th,—ten weeks after operation,—and the wound was permitted to close. The patient made an uneventful recovery.

ACUTE CHOLECYSTITIS WITH DIFFUSE PANCREATITIS—CHOLECYSTOSTOMY

Summary: Clinical history of patient; comments—significance of jaundice when preceded by colic and when not preceded by colic; operation—gall-bladder distended, inflamed, adherent; pancreas enlarged and thickened—pancreatic lymphangitis; no calculi in biliary tract; cholecystostomy performed; postoperative comments—when to remove drainage from gall-bladder; "offensive" *vs.* "defensive" pus; value of *x*-rays in detecting gall-stones; correlation of patient's history with operative findings; table of gall-stones; behavior of gall-stones.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-nine years of age, was admitted to Mercy Hospital November 30, 1915. The family history and the past history are negative.

The present malady began five months ago, on July 1st. The first symptom was a dull, lumbar backache, usually beginning about 6.30 P. M., and lasting until 10 P. M., and accompanied by a slight diarrhea. The pain became more severe and the diarrhea more profuse. Three weeks after the onset of the trouble there began a dull ache in the right upper quadrant of the abdomen, which was constant except when relieved by bowel action; and gas-distention of the abdomen, which caused great distress: much gas was passed by rectum. The patient's appetite began to leave him, food nauseated him, he began to lose weight, and became weak and pale.

Four months ago, on August 1st, the abdominal pain and distention suddenly disappeared. The bowel movements, however, increased from 6 to 15 a day: the stools were watery and claylike, there being a yellowish sediment which settled to the bottom of a clear, watery fluid. The dysentery continued for seven weeks.

On September 22d, at midnight, there was an attack of severe pain in the lumbar region of the back, which lasted one-half hour. On September 23d and 24th the pain recurred at the same hour and again lasted one-half hour.

On September 25th the patient went to the hospital, and from that time until October 8th the backache continued to be very severe, but the diarrhea lessened.

On October 8th the liquid was changed to a solid diet, and about 8 P. M. the patient vomited for the first time, and during the next week vomited on four different nights.

On October 14th the patient vomited seven or eight times in from one and one-half to two hours: the vomitus consisted of yellowish, watery fluid, and was frothy and very bitter. It was not associated with colic.

On October 15th jaundice appeared. There was no chill or fever. The watery bowel-movements gradually stopped, although the patient still has frequent bowel-movements, which are semi-solid and very dark. There has been no pain since the onset of jaundice.

On October 20th the patient's appetite began to return. He gets very hungry and relishes all food except sweets, which seem to nauseate him.

During the past three months bowel-movements have averaged four or five a night, the bowel action always being accompanied by gas. The urine is very dark. The patient has lost 35 pounds since the onset of the malady.

On December 2d, two days after admission to hospital, the patient vomited 1½ drams of a dark fluid suddenly and without warning. Gastric lavage on that day produced a dark-brown fluid, and the next day, a clear fluid.

Examination by Dr. Murphy (*December 6, 1915*).—The gall-bladder is palpable; the liver is smooth and not nodular. There is a wood-like induration in the zone of the pancreas, extending clear across under the left costal arch. Of 13 skiagrams taken between November 25th and 30th, 6 were interpreted as showing gall-stones.

COMMENTS

DR. MURPHY (December 8, 1915): Jaundice that comes on without colic is not due to cholelithiasis. In this case it is difficult to interpret how much pain was present for the three days preceding September 25th. Was the pain severe enough to be termed a cholelithic colic? The patient stated that he was not doubled up by the pain, and that the pain was in the loin; if the history is correct, there was jaundice alone, without frank cholelithic colic. Examination, however, is more suggestive than the history. Across the abdomen there is a mass of infiltration which is as hard as wood, as though malignant. Acute infection of the pancreas liberates steapsin, and this fat-splitting ferment gives rise to a wood-like induration which simulates carcinoma.

The diagnosis in this case is not cholelithiasis, therefore, but pancreatitis, or a neoplasm which is producing the obstruction to the bile-ducts and giving rise to jaundice. There is a definite law concerning jaundice which we laid down many years ago in our experimental work, namely, that if jaundice was not preceded by colic, the chances are 96 per cent. that it is not a cholelithic jaundice. If, on the other hand, the jaundice was preceded by colic or recurrent colicky pain, the chances are 90 per cent. that it *is* a cholelithic jaundice.

There is danger in operating upon this patient because of the presence of the intense icterus, which, however, does not give rise to so pronounced a tendency to bleeding as icterus due to a malignant lesion gives rise to.

Laboratory Report: Blood coagulation period is two minutes.

OPERATION

Note that I am making a small incision, because the operation must be primarily exploratory. . . . The whole wound oozes freely, although, according to the report from the laboratory, the coagulation time is two minutes. [Retracts wound.] . . . The gall-bladder is enormously distended, acutely inflamed, and firmly adherent. The pancreas is greatly enlarged and thickened far to the left of the median line; there are many enlarged regional lymph-nodes. [Frees adhesions and elevates gall-bladder.] . . . Is there a cholelithiasis which is producing the obstruction, or is the obstruction due to pancreatitis? I must take the tension off of the gall-bladder before being able to determine the presence of stones by palpation. [Aspirates gall-bladder.] . . . The bile is at first cloudy, but soon becomes thicker, like glycerin, and comes out more slowly: it contains flakes of mucus which occasionally obstruct the needle; and finally there is purulent *brie* at the bottom of the gall-bladder. There are no stones in the gall-bladder, the cystic duct, or common duct—in complete accord with the clinical history.

Mechanically made diagnoses never take the place of those made with the cortical cells, as illustrated in this case—note the erroneous interpretation of the skiagram. The gall-bladder tells the story of acute infection with infiltration. This infection had been present a long time before it finally involved the head of the pancreas: note the history, indicating that the pancreatic lesion began September 25th and the gall-bladder infection took place July 1st. The indication to be met now is the relief of the cholemia, which, if it continues together with the sepsis, will eventually kill the patient. Had there been an organic obstruction, our plan would have been to "button" the gall-bladder to either the large or small intestine, but since the condition is entirely inflammatory, such a step is unnecessary. It was for the purpose of "coupling" the gall-bladder to the intestine that the button was originally brought out.

If the sepsis subsides, this gall-bladder will return to normal: I shall, therefore, perform cholecystostomy. That looks like a very badly wrecked gall-bladder, and I would perform cholecystectomy were it not that I wish to drain the pancreas through the gall-bladder. The drainage-tube will be retained for a long time. The cultures taken now will be negative, for the fluid in these viscera does not necessarily show a growth even in the presence of pus. In the experiments of Dudgeon and Sargent in connection with pus in the peritoneal cavity the analysis showed that from 50 to 60 per cent. of the pus taken from the peritoneum was sterile, meaning that the bacteria-laden polymorphs have been carried away. If, however, a piece of omentum is placed in a culture-tube, a growth immediately ensues, just as when, in this class of cases, if a section of the gall-bladder is ground up and cultured, a growth will be obtained.

I shall make a small incision into the gall-bladder and evacuate its contents. . . . The mucosa is very much thickened, and the bile is too viscid and ropy to flow through the needle of the syringe: the thickest bile has, of course, gravitated to the lower end of the gall-bladder. [Introduces purse-string suture.] . . . This stitch acts as a constrictor to prevent the cut edge of the gall-bladder from bleeding into the organ itself. [Ties suture tight.] . . . I must now make the cut edges of this gall-bladder mechanically a part of the rubber drainage-tube, so that the latter cannot separate and get away. [Passes stitch through gall-bladder and tube on each side and removes both hemostats which held gall-bladder.] . . . Now we shall try to turn the end of the gall-bladder in and then insert the second row of sutures, or the second defense-line against leakage. [Inverts fundus of gall-bladder.] . . . See how nicely the fundus is turned in! As the gall-bladder rolls up, it folds the inner row of sutures down into the organ and makes an entropion of its edges. That is not enough security, however, for the gall-bladder must be bound to the tube: there will be no leakage from putting the needle through the latter. [Sutures gall-bladder to tube—for technic see vol. iv, October, 1915, Fig. 231, p. 903.] . . . Now there will be free and ample drainage of the pancreas. All the gauze sponges I have used are stained yellow, not from the bile in the course of my work, but from the secretion in the peritoneal cavity, which is yellow. [Closes abdominal wound, making usual ectropion of cut peritoneal edges and allowing room for drainage-tube.]

POSTOPERATIVE COMMENTS

The pancreas is enlarged to five or six times its normal size; it fills the whole upper abdomen; there are fat-necrosis flakes in the omentum and mesentery; there is no evidence of fluctuation in the pancreas. It is questionable whether this pancreas is capable of restoration; that is, whether it is not so necrotized by the infection that it will not again resume its function, in which case the patient will die.

We have a rather definite law when to remove these drainage-tubes: the gall-bladder will be drained until its mucosa ceases to resemble a granulated eyelid when seen through the cystoscope; thereupon the tube will be removed and the wound permitted to close. So long as the granulated-eyelid condition persists, however, the infection has not been overcome.

In this case drainage must be continued for a much longer period of time, in the hope that it will drain the pancreas.

Many years ago, in writing the article on appendicitis, I used the expressions "offensive" pus and "defensive" pus. I made the point that in the peritoneal cavity the "defensive" pus was nothing more than a serous fluid filled with monomorphs and polymorphs—the quantity of pus cutting no figure whatever as to the presence or absence of living microörganisms. "Offensive" pus comes, for example, from a ruptured appendix, where there is offensive gangrenous material discharged from the appendix into the peritoneal cavity. Polymorphs are soldiers and build defenses against infection, and they are the real modern types of soldiers: when they get a microörganism, they treat him as a foe and not only kill, but also digest him.

Some one has asked me about the value of x-rays in detecting gall-stones. While fully appreciating the value of x-rays, yet I deem them only a support to the clinical history, and in the great majority of cases the diagnosis of gall-stone cannot be made with x-rays alone. As a result of his x-ray examinations, George, of Boston, through his superlative skill, is having a very large percentage of gall-stones show up in the pictures, and they are found with great uniformity at operation. It is estimated that when gall-stones are present, the x-rays will reveal them in about 50 per cent. of cases. But we know that one individual in every ten has gall-stones, and if one should interpret every case of upper abdominal symptomatology where gall-stones are found in the skiagram as "a gall-stone case alone," he will overlook an enormous number of other lesions which are associated in a patient with gall-stones. X-rays, therefore, should be employed merely as an adjunct and support to the clinical history, just as the reports of the pathologist and bacteriologist are mechanical aids which, in diagnosis, merely support the clinical course of the disease.

* * * * * * * * * * * * * * * * * * * *

Let us now see how the patient's history exactly fits the pathologic findings, and how it is at variance with the diagnosis put on the board (cholelithiasis), to which I objected when I came into the amphitheater.

[Intern reads history again.] . . . That is the patient's own story: it fits exactly the pathologic findings. He had originally an infection of the gall-bladder without colic and with pain in the back; then he had an infection of the pancreas, which became greatly infiltrated and simulated carcinoma: the common bile-duct often passes through the head of the pancreas, and with an acute infection or a cancer of the pancreas the common duct may be occluded, giving rise to jaundice as one of the very common symptoms, but it is not preceded by colic.

Physical examination revealed a mass of wood-like hardness, transversely elongated across the abdomen and presenting a number of hard nodules at its upper and lower borders. On perpendicular finger-percussion over the gall-bladder the patient was very sensitive to pressure, showing merely that the organ was under tension. Then the question came up as to Courvoisier's law, which was laid down in the beginning of gall-bladder work away back in 1889: this law is to the effect that the gall-bladder is contracted in 80¼ per cent. of the cases of cholelithiasis with jaundice; while it is enlarged in 90½ per cent. of the cases of obstructive jaundice from causes other than gall-stones. We decided, therefore, that the patient was suffering from pancreatitis, which was sequential to infection of the gall-bladder; and that the icterus was due to the compression of the duct by the infected pancreas and to the edema of the duct which was sequential to the infection, and not due to biliary lithiasis, because, in my article in Sajous' "Encyclopedia" in the early nineties, I laid down the law that jaundice not preceded by colic is never a foreign-body jaundice, while jaundice which is preceded by colic *is* a typical foreign-body jaundice.

Colic never arises in the so-called malarial jaundice, although there are pain and discomfort. Colic never arises in the case of obstruction to the common duct from cancer of the pancreas, no matter how severe it may be: the duct may be compressed until it is almost entirely obliterated, but colic never occurs. *Colic is the manifestation of a foreign body in motion in a living tube.*

Thus a free stone in motion in the cystic duct gives rise to colic, but once it becomes stationary, as in a diverticulum, the colic disappears. There may be a stone in the common duct and no colic, but once the stone begins to move onward, then new manifestations arise in the shape of colic and cramp. There are a few exceptions to this rule, one of which is the large, wedge-shaped stone that becomes jammed in the duct, so that it does not give rise to colic. The stone may be an inch in diameter at the base and ¼ inch at the apex: such a stone was found in the case of a physician from Vancouver, operated upon by me in 1895, who gave a history of pain in the upper abdomen for a number of years and came in nine months after having had the jaundice. He was a young man about thirty-five years of age. I explained the law to him, adding that he presented an exception, for the stone in his case must be so large that it does not admit of spasm of the duct (colic), but he was not suffering from cancer notwithstanding that the obstructive jaundice came on without colic. At operation we removed a large, wedge-shaped stone which extended clear down into the common duct: the gall-bladder was contracted down to a little cicatricial mass.

TABLE GIVING DATA ON GALL-STONES

Two methods of formation:

1. Naunyn's septic.
2. Aschoff's aseptic.

ANALYSIS OF BILE:	(*a*) LIVER BILE	(*b*) GALL-BLADDER BILE
Solids	2.060	16.020
Water	97.940	83.980
Mucus and coloring matter	0.276	4.438
Alkaline and bile salts	0.847	8.723
Taurocholate	0.106	1.934
Glycocholate	0.741	6.789
Fatty acids and soap	..	1.058
Cholesterin	0.078	0.870
Lecithin	0.028	0.141
Fat	..	0.150
Soluble salts	0.802	0.302
Non-soluble salts	0.020	0.236

Frequency: Roth, in Basle Pathologic Institute, in 16,025 necropsies from 1891 to 1910, found that 10.4 per cent. of all the bodies examined had gallstones. Males, 5.9 per cent., and females, 15.25 per cent. Practically 1–7.

Etiology:
1. Bile stagnation.
2. Precipitation of cholesterin.
3. Accretions of bile salts.
4. Accretions of calcium salts.
5. Influence of infection.

Types of stones:
1. Pure cholesterin.
2. Coated cholesterin.
3. Calcium.
    a. The layer of calcium and cholesterin.
    b. The cholesterin pigmented and calcium.
    c. Bilirubin calcium.

Where are these gall-stones formed? Almost all gall-stones are formed in the gall-bladder. Ninety-eight per cent. by weight of all gall-stones is cholesterin, which is the product of dead epithelial cells lining the gall-bladder. In their formative stage gall-stones are soft and putty-like, and then they begin to crystallize suddenly, just as maple-syrup crystallizes. Each group of stones forms in practically the same shape: sometimes one can distinguish two or three crops of stones in the gall-bladder and deduce therefrom that two or three crops of crystals were formed.

Gall-stones are present in one individual out of every ten, but they produce trouble only when mechanically disturbed by irritating or obstructing a duct. An acute infection is what starts the gall-stones forming (Naunyn), so that gall-stones differ from urinary calculi, which are many times the precipitation of salts that have been in solution in the urine. Gall-stones begin to produce trouble first and most commonly in the gall-bladder—one has pain in the gall-bladder often without colic, and that pain may be recurrent for years; secondly, when the stone passes from the cystic duct and is larger in diameter than the lumen of the duct, it gives rise to typical colic not associated with jaundice; with a stone in the neck of the gall-bladder or cystic duct patients may have recurrent colic without jaundice for as long as thirty years; finally, when the stone has progressed far enough to escape from the cystic into the common duct, then for the first time jaundice occurs, and if the stone is large enough to produce obstruction, the jaundice continues as long as the stone is in motion. The stone may be stationary, and if small, the bile may pass around it, the icterus slowly subsiding to a mild bronzing, which may be present with no bile in the urine for one, two, three, six, or even ten years until the stone begins to move again; now the cycle is repeated, the swelling from edema of the mucous membrane obstructs the passage of the stone, jaundice arises and may again subside after the stone is arrested.

At one time we believed that the icterus continued so long as the stone remained in the common duct. On the contrary, with the stone still in the common duct the icterus may entirely disappear, but there is the history of primary jaundice at the time the stone entered the common duct. I recall a patient from Tennessee who had been slightly bronzed for five years without ever having had colic: the bronzing began originally with severe jaundice. When we pinned her down to an accurate statement, however, she said that for four years preceding the jaundice she had had "gastralgia." Now we know that for years "gastralgia" was the regular name for gall-stone disease: that is what everybody called it. They figured that if she had gall-stones she would have to be jaundiced. You can now understand how one can have colics or pains for thirty years without having the stones get into the common duct, and how cholelithic jaundice never occurs unless the stones get into the common duct. As soon as the jaundice came the patient stopped having the "gastralgia," for when the stones leave the cystic duct and enter the common duct the "gastralgia" stops and the jaundice begins. At operation we found the common duct filled with stones. I wish to emphasize the fact that the pain stops when the stone ceases to move or obstruct: in this girl's case the colic stopped five years previous to the time of operation.

Postscript (*February 26, 1916*).—[Demonstration at Clinic.] This patient had an acute infection of the pancreas from the gall-bladder, producing the most intense jaundice I have ever seen: it was so intense that I felt he would bleed to death if we touched him, but the tissues did not bleed much, despite the cholemia. The pancreas was one solid mass of infiltration, and showed how severe the infection had been. There is practically nothing left of the pancreas, for the other day we gave the patient olive oil, which was passed unchanged as olive oil, showing that there is no fat-splitting ferment left. We are giving him pancreatin, although we have not very much confidence in it, but at the same time we give it because it is supposed to have an effect.

He had recurrent diarrhea with no emesis, gradual emaciation, and notwithstanding the fact that we refed him his own bile, the marasmus continued and terminated fatally March 28, 1916.

CHRONIC CHOLECYSTITIS—PANCREATIC LYMPHANGITIS—METASTATIC ARTHRITIS—CHOLECYSTECTOMY

Summary: Clinical history of patient; comments—salient features of case presented by Dr. Mix; operation—correlation of symptoms and signs with pathologic findings; gall-bladder greatly infiltrated, suggesting malignancy; cholecystectomy; postoperative comments—review of pathology of gall-bladder.

CLINICAL HISTORY OF PATIENT

A FEMALE, fifty-nine years of age, was admitted to Mercy Hospital December 8, 1915. The family history reveals no tuberculosis or malignancy.

When a child, the patient suffered from intense jaundice for a long period of time.

During the past fifteen years the patient has been subject to attacks of indigestion, usually following a full meal: the chief feature of each attack was a "lump" which gathered just under the sternum on the right side; relief was obtained by self-induced vomiting, usually about two hours after the onset of the attack. The attacks occurred at intervals of three or four months. There was no distinct cramp-like or sharp pain in the region referred to. Chills and fever, nausea and vomiting, were absent, except as above stated. Blood was never vomited nor passed in stools.

In 1902, while cleaning a clothes-closet one hot afternoon, the patient was prostrated by a sudden attack of syncope, and for two days showed subnormal temperature. When recovering from this attack the patient noticed severe pain in the back of the head and neck, and a tender spot over the occiput on the right side, which prevented her from resting at night on that side. The headache was almost constantly present for two years, and was relieved by osteopathic treatment: the dizziness still persists, however.

In June, 1913, the patient noticed the left ring-finger beginning to swell at the proximal interphalangeal joint: the enlargement increased slowly for almost one year, when, in May, 1914, it rapidly increased in size, so that within one month it was four times as large as the corresponding finger on the right hand. The swelling of the finger subsided under treatment, but at present it is stiff at the proximal joint and cannot be fully flexed.

Since their onset the attacks of indigestion have continued at infrequent periods, but were not accentuated during the time the finger was enlarging. The patient is not subject to sore throat, but states that one tonsil is enlarged.

Early in May, 1915,—seven months ago,—there was a severe attack of indigestion characterized by cramp-like abdominal pain and by a sensation of distention which was so distressing that an anodyne was required. Four hours after the onset of the attack the patient obtained relief by vomiting a large quantity of bile after being given a hypodermic injection of apomorphin. Tenderness persisted over the upper abdomen for several weeks; there was no chill or fever, nor was the patient jaundiced.

A second attack occurred two months later, on July 4, 1915: it was quite similar to the one just described.

A third severe attack occurred four months later, on November 3d: the urine was very dark, and the physician stated that the patient's eyes were yellow. The attack lasted for one day and was relieved by emetic doses of apomorphin. Since this attack the patient has been very tender over the upper abdomen.

Last month the patient was operated upon for hemorrhoids which had been present for about ten years.

Within the past two months the patient's weight has been lowered by about 12 pounds; the appetite is fair; the bowels are greatly constipated and require a cathartic.

COMMENTS

Dr. Murphy (December 13, 1915): The patient's narrative spans a long period of time and possesses two salient features. First, the indigestion, with at times gall-bladder retention-signs, but no signs of continued obstruction. The other feature is that of signs of intestinal intoxication with joint-manifestations from metastatic infection. The more recent signs point toward the gall-bladder as the seat of trouble. Dr. Mix has had the patient under observation for some time, so that I shall request him to discuss the history with you.

Dr. Mix: The history which I myself obtained from the patient varies in some essential details from that given by the intern. The most important omission is the story of a very intense jaundice when the patient was seven years of age. According to her story the icterus was of a malignant type, in that it was associated with a tendency toward the formation of black and blue spots on her body wherever she was touched. Cholemia of great severity tends to affect the walls of the veins to such an extent that diapedesis of the red blood-cells is extremely easy, and rupture of the vessel-wall by no means infrequent after the slightest trauma. She was intensely jaundiced for weeks, and her color was permanently changed. Before this jaundice she was a flaxen-haired blonde, but after the jaundice her skin took on a darker hue, which it has retained up to the present time.

The patient is inclined to place the beginning of her disturbance in the year 1900, when she began to be bothered with attacks of indigestion. The important point in the record of these attacks is that usually they were of *short periodicity*. They lasted only a day or a part of a day, and, as a rule, were the result of indigestion following a very full meal. After a full meal a "lump" seemed to gather under the sternum and to the right side. If the patient forced herself to vomit,—as she frequently did, by putting her finger down her throat,—she would be relieved of this lump, and the attack of indigestion would be over.

A second important feature is that at about this same time she was troubled with *signs of infection*. To be sure, there is no history of chills or of fever at this early date, but there is a history of attacks of very pronounced headache, which lasted for about two years up to 1902. Such headaches associated with attacks of indigestion of short periodicity, with a disagreeable feeling beneath the sternum, and to the right side, are fairly suggestive—taking into consideration, furthermore, the early history of icterus—of biliary tract infection.

Substantiating this conclusion is the history of the absence of hematemesis or melena, and the *presence of bile in the vomitus.* Bile in the vomitus is a sign of a peritonitic irritation of the upper abdomen, and especially of the right quadrant. It means reversal in the direction of the peristaltic wave, which is reflex in origin, from a diseased or irritated peritoneum. It can occur in perigastritis, periduodenitis, and pericholecystitis. Biliary tract infections are very apt to lead to peritonitic irritation from involvement of the peritoneum about the gall-bladder. Frequently the gall-bladder becomes adherent to the adjacent structures,—especially to the duodenum and occasionally to the pylorus,—in which cases vomiting of bile is by no means unusual.

Still another point in the patient's history may be used to strengthen the diagnosis of biliary tract infection, and that is, the presence of vertigo. Usually in an individual fifty-nine years of age vertigo means arteriosclerosis, but if you recall the history, the vertigo appeared as far back as 1902. Vertigo appearing so early is apt to be due to causes other than arteriosclerosis, and is not infrequently associated with biliary tract infection. I should interpret the vertigo in this case as being due to disease of the biliary tract, rather than to chronic arteriosclerosis.

Aside from these preliminary remarks, which are somewhat conjectural, we have *three important seizures* of great diagnostic import. The first attack was in May, 1915. The patient told me that this attack came on about 12 o'clock midnight. It was associated with a very slight chilly sensation, but so far as she knows there was no fever. She was nauseated, but did not vomit until after a hypodermic injection of apomorphin. This induced vomiting, and aborted the attack after the latter had lasted for about two hours. No jaundice followed this attack, but she says that she did notice that she passed putty-colored stools about that time. She also noticed that she was tender over the upper part of the abdomen for several weeks following this attack in May.

The second attack occurred on July 4th. This, she remembers distinctly, was associated with a pronounced chill and with slight fever. She also says that the physician who attended her noticed a trace of icterus appearing in the scleræ after the attack. This attack was also controlled by apomorphin, which, by causing her to vomit, emptied the stomach and aborted the attack.

The third attack occurred in October, 1915. This was very severe for one day, and was relieved by the hypodermic injection of a drug, the nature of which she does not know. This attack kept the patient in bed two weeks. Although the great severity of the pain was of only one day's duration, yet she was so prostrated by suffering that it was judged best for her to remain in bed two weeks. An indication of the amount of pain which she had at this time is the fact that she was burned with a hot-water bottle. This hot-water bottle not only burned the skin, but indicated to us pretty clearly where the pain was. The place of the burn is located beneath the right costal border and in the right flank. Evidently the pain was most intense in this territory. Following this attack in October she noted that her bowel-movements had a clay color on several occasions, but they were not constantly of clay color. There was also much tenderness beneath the right costal border, lasting for a period of eight weeks, following this attack in October.

When one takes into consideration these three attacks,—the first in May, the second in July, the third in October,—all similar in character and associated with very severe pain, relieved by vomiting,—induced on two occasions by apomorphin,—all associated with tenderness beneath the right costal border, two with putty-colored bowel-movements, one with a very slight amount of icterus in the sclerotic coats, there can be but one conclusion, and that is, that the patient is suffering from biliary tract infection.

There is another symptom of very great importance to be mentioned, and that is that in June, 1913, the ring finger of the patient's left hand in the joint between the middle and proximal phalanges began to swell until in one month it was twice the size of the corresponding finger on the right hand. The patient, who is a woman of means, consulted several physicians in regard to this joint-trouble, and received various diagnoses. By one surgeon a diagnosis of sarcoma was made, and it was proposed that the finger be amputated at once in order to prevent a subsequent necessary amputation of the whole hand or arm. Another surgeon suggested that it was arthritis of intensity great enough to require resection of the joint. She objected to this because she did not want her finger to stick out like a poker. She thought it was better to have it remain larger and capable of being bent, rather than to be reduced in size and kept stiff. She, therefore, refused to have anything done. The finger looks like an ordinary dactylitis, on either a tuberculous or syphilitic basis. A Wassermann examination was found to be negative. A tuberculin test also turned out negative. There remained only one conclusion, and that was that this joint-disease was associated with some focus of infection somewhere in her body. Indeed, it was this joint-disease which led to the discovery of the gall-bladder trouble, because it was the joint-disease which brought her to my office and which led to an investigation of the case. Evidently the joint—since it had proved to be neither tuberculous nor syphilitic—was gouty or metastatic. On the theory that it might be gouty she was examined very carefully for gouty manifestations elsewhere, but none was found. On the theory that it might be metastatic she was examined for signs of disturbance elsewhere, and then the gall-bladder history was discovered.

Physical examination shows no tenderness over the appendix. There is no history, nor any element pointing to disease of the appendix at any time in the patient's life. The urine at the present time shows a trace of bile,—indicating the existence of biliary tract infection,—normal color and normal specific gravity, and the absence of albumin, sugar, casts, and red cells. There is no history of disturbance on the part of the stomach, except such disturbances as occurred at the time of the biliary seizures. When her gall-bladder trouble is latent, she never has any gastric disturbance. There has never been pain between the attacks in May, July, and October, either in the duodenal area or in the epigastrium. The entire freedom from disturbance on the part of the stomach between these very short storm-periods certainly evidences the absence of ulcer of either the stomach or duodenum.

Inasmuch as there is no evidence of appendicitis, so far as physical examination or history is concerned; since there is no evidence of gastric or duodenal ulcer in the history or in the results of physical examination; and since there is a focus of infection, as shown by the slight chilly sensations, occasional fever with headache and vertigo, short periods of painful activity and comparatively long periods of freedom from trouble, no history of hemorrhages, but three important painful seizures of short duration occurring in May, July, and October, we are forced to the diagnosis of biliary tract infection, with or without gall-stones. As we have no history which points to clear, colic-like attacks of pain, we are not justified in diagnosticating the existence of gall-stones. The duration of the case, however, as well as the intensity of the biliary tract infection, suggests that stones are present; rather than absent.

OPERATION

Dr. Murphy: Dr. Mix's interpretation of the symptoms and signs is exactly in consonance with the pathologic facts as revealed by our incision: the gall-bladder reveals the typical stippling of infection and is firmly bound down to the pylorus. [Frees gall-bladder from adhesions to pylorus.] . . . The stomach reveals neither ulcer nor beginning cancer. There is no calculus in the biliary tract, but there is a slight thickening of the head of the pancreas. The gall-bladder is so badly diseased that it does not resemble a gall-bladder: this infection probably accounts for the metastatic joint-infection. The gall-bladder feels suspicious: its walls are so thickened by infiltration as to suggest malignant degeneration. [Performs cholecystectomy.] . . . Upon opening this gall-bladder we find that the mucosa is not malignantly infiltrated, so that the thickening of the organ itself is probably the sequence of infection, since carcinoma is always a primary lesion of the mucosa. The infiltration has extended into the liver. [Cauterizes stump of cysticus with 95 per cent. phenol.]

This gall-bladder was infiltrated to the superlative degree:

as soon as you look at it you do not wonder that metastatic arthritis and rheumatism arose from it as the primary focus. I feel greatly relieved that the infiltration is inflammatory and non-malignant in type. [Applies and secures drain to stump of cystic duct.] . . . If the duct begins to leak bile,—as it sometimes does,—we may rest assured that good drainage has already been established. The firm binding of the gall-bladder to the pyloric zone of the stomach accounted for the recurrent obstruction-retention without an organic obstruction. To prevent reformation of these adhesions I am covering over the abraded surfaces with the gastrohepatic omentum. . . .

The post-operative fixation of the pyloric zone of the stomach to the liver seriously interferes with the patient's comfort following cholecystectomy; and it is for that special reason more than any other that we are not performing more cholecystectomies.

POSTOPERATIVE COMMENTS

The clinical history of this patient may readily be correlated with the pathologic findings. The thirteen or fourteen years of gastric disturbances, for example, were due to infection, fixation, and obstruction of the gall-bladder: gall-stones do not do the mischief themselves, but it is the pathologic changes induced by the gall-stones. Every gall-stone is primarily an infection-sequence—that is, the stones are formed from infection of the gall-bladder (Naunyn); these foreign bodies, by their presence in a more or less infected zone, keep up a continued production of cholesterin, which, in turn, keeps increasing the number of stones until finally there is the arrest of the microörganisms of a more virulent type, which start up suppuration in the gall-bladder. This patient's gall-bladder contained pus as well as *brie:* such a white gall-bladder always results from infection. The virulence of the infection was spread over a long period of time, and the ensuing pathologic changes caused the gall-bladder to contract as much as possible upon its contents.

This cicatricial contraction of the gall-bladder consequent upon infection accounts for that part of Courvoisier's law which states that the gall-bladder is contracted in 80¼ per cent. of the cases in which the common duct is obstructed by stone.

When the ligature on the cystic duct cuts through,—usually on the sixth or seventh day,—there is a leakage of bile for some days: I consider this a fortunate, rather than an unfortunate occurrence, for it aids in the drainage of the pancreatic zone.

Pathologist's Report.—Examination of the gall-bladder revealed total destruction of the mucosa by a chronic inflammatory process with much connective-tissue reaction. There were small hemorrhages with edema in the layers of the wall. *Cholecystitis chronica* with ulcer-formation: no malignant changes in region of ulcers.

Postscript.—The patient made an uneventful recovery and left the hospital within the usual time.

CHOLELITHIASIS, PANCREATITIS, APPENDICITIS—CHOLECYSTOSTOMY, APPENDECTOMY

Summary: Clinical history of patient; comments—rôle of appendiceal sepsis in etiology of gall-stones; sites of formation of gall-stones; operation—stones in gall-bladder, pancreas enlarged; cholecystostomy, appendectomy.

CLINICAL HISTORY OF PATIENT

A MALE, forty-seven years of age, was admitted to Mercy Hospital January 5, 1916. The family and past histories are negative.

During the past twenty years, at intervals of one year, in addition to headaches, the patient has had griping pains in the right lower quadrant of the abdomen: the pains were followed by nausea and vomiting, tenderness over the lower abdomen, and fever; the patient was incapacitated for several days, and each attack was followed by constipation.

Six months ago, in July, 1915, the patient had a sharp attack of pain, which began near the navel and gradually radiated to the right iliac fossa: the pain was so severe that it doubled him up, and he was given a hypodermic injection of morphin; fifteen minutes later he became nauseated and retched, but did not vomit. Fever came on, and the patient had a severe chill: he remained in bed three days and then felt fairly well.

Eight weeks ago, on November 12, 1915, the patient was awakened by a sharp cramp in the lower abdomen, which gradually radiated around to the right iliac fossa: the cramp was followed by nausea and vomiting, and at the end of half an hour by a chill and fever of 101° F. He was treated with cold compresses and medicines for one week when, on November 19, 1915, he had another severe attack of abdominal pain, localizing in the right iliac fossa, with nausea and vomiting, chills and fever: his abdomen was distended and very tender, and he passed neither flatus nor feces; he was very deeply jaundiced and his urine was dark. The next day he was operated upon: a large appendiceal abscess was incised and drained; the appendix was not removed; after a week's drainage the wound healed.

One week ago, on December 29, 1915, the patient had a sharp cramp in the right upper abdominal quadrant, which was so severe that it doubled him up. The cramp gradually diminished in intensity and became dull and aching. The patient was distended and very tender over this region. He had no chill or fever, but his conjunctivæ showed slight jaundice. The next day the stools were clay-colored and putty-like, and the urine was very dark: later the patient became very much jaundiced. Similar attacks, attended with slight fever, occurred three days and two days ago, and on the day of admission.

COMMENTS

Dr. Murphy (January 11, 1916): It is now five days since the patient had his last attack of colic, and since then his jaundice has very materially cleared up, so that we hope the stone, which we presume to have been in the common duct, has left that duct.

I should like to inquire what rôle the sepsis from the appendix, which he has had for a number of years, played in the production of the gall-stones. For a long time it was believed that gallstones were always the sequence of infection, but we are left in doubt by the more recent experiments of Aschoff, who concludes that stones are formed, without infection, from the cholesterin from the dead epithelial cells of the gall-bladder.

Most gall-stones are formed in the gall-bladder: occasionally one is formed in a diverticulum or a small dilated intrahepatic duct. Courvoisier reported finding a large number of gall-stones in the hepatic duct; but these stones were, in fact, formed in the gall-bladder and were forced into the hepatic duct during the contraction of the gall-bladder because the common duct was obstructed by a larger calculus.

In an article entitled, "Intrahepatic Cholelithiasis," Lewisohn (*Annals of Surgery*, May, 1916, 535–540) writes:

"The question of the formation of intrahepatic stones is of the greatest interest to the surgeon. Every surgeon will experience cases where, after a previous cholecystectomy and a thorough removal of common duct stones, he has to reoperate on account of jaundice. At the second operation, he again finds stones in the common duct. The question then arises: Were these stones overlooked at the first operation? . . . The stones removed from the hepatic ducts differ absolutely in shape, color, and character from the stones found in the gall-bladder. . . . *It is therefore beyond doubt that intrahepatic stones can be and are formed in the liver.*" [Italics ours.] (See Figs. 81, 82.)

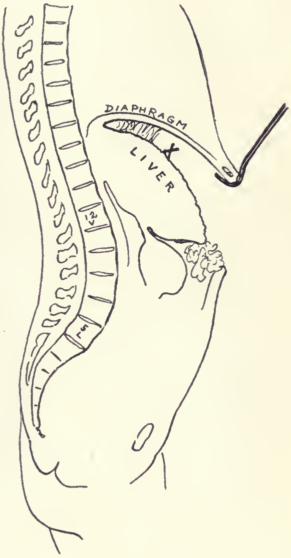

Fig. 81.—Diagrammatic side view. X, Removal of intrahepatic stones from the diaphragmatic surface of the liver (Lewisohn in *Annals of Surgery*).

It has not been an uncommon experience to have gall-bladder symptoms with or without infections manifest themselves shortly after acute attacks of appendicitis. Dr. C. H. Mayo's case was a striking one of that type.

OPERATION

[Celiotomy through vertical incision in outer portion of right rectus muscle above navel: edges retracted.] . . . The gall-bladder is non-compressible, thickened, and white: there is a stone impacted in the cystic duct, which we have succeeded in pressing back into the gall-bladder. The head of the pancreas is infiltrated and contains quite a notch: this infiltration interferes with exploration of the common duct for stone. [Unsuccessful attempt made to aspirate gall-bladder: incision then made through fundus.] . . . The bile is thick and viscid and contains millet-seed stones, so that aspiration was futile. I am removing several stones with the spoon, as well as a large quantity of thick, rope-like bile. . . . Exploration of the common duct reveals no stone. [Performs cholecystostomy in the manner described above on p. 405.] . . .

On November 20th the patient was operated upon for appendiceal abscess, but the appendix was not removed. We shall take advantage of the present opportunity of removing the organ, for if we do not, the chances are that we shall have to remove it subsequently during an attack. [Exposes appendix; encounters firm, dense adhesions; stump of chronically diseased appendix was removed; sponges and instruments accounted for; celiotomy wound closed with allowance for exit of drainage-tube.] . . .

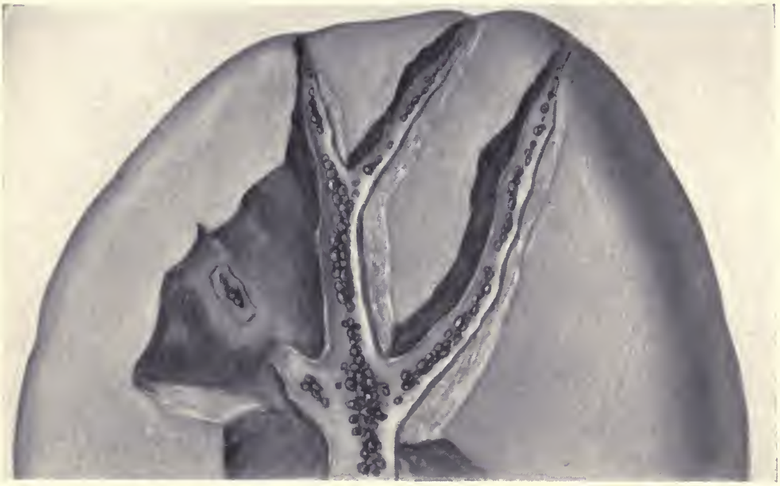

Fig. 82.—Postmortem specimen illustrating intrahepatic cholelithiasis (Lenhartz).

Postscript (*January 28, 1916*).—The patient's condition is splendid: his convalescence has been uneventful.

CARCINOMA OF CHOLELITHIC GALL-BLADDER—EXPLORATORY CELIOTOMY

Summary: Clinical history of patient; comments—question of the girdle-pains of tabes; table showing useless surgical operations in tabes; review of history; diagnosis of palpated nodule; operation—exploratory; postoperative comments—"silent" gall-stones; primary sarcoma of gall-bladder.

CLINICAL HISTORY OF PATIENT

A FEMALE, fifty-three years of age, was admitted to Mercy Hospital January 22, 1916. The family history is negative. Nineteen years ago, when seven months pregnant, the patient suffered an attack of typhoid fever, which lasted six weeks. She has also been operated upon for hemorrhoids.

One month ago, on December 23, 1915, the patient had a severe, sharp cramp in the right upper quadrant of the abdomen, which radiated around to the back and upward to the right shoulder: it was not severe enough to double her up, and after about two hours gradually subsided into a dull ache. She had neither fever nor chill; did not feel nauseated; did not vomit, nor was she jaundiced after the attack. The stools the next day were of normal color and consistency—not clay-colored—and contained neither mucus nor blood. The dull ache in the right upper quadrant continued.

Three days later, on December 26th, there was another similar attack of pain, which was relieved by medicine, but which left in its wake tenderness over the right side of the epigastrium: even the pressure of the bed-clothing was annoying.

Four days later, on December 30th, she had another attack of pain in the epigastrium which lasted all day, and which was followed by a dull, aching, dragging sensation, radiating toward the shoulder. The stools were normal, and the bowels moved every other day.

These attacks repeated themselves at intervals of about two or three days up to the present time. The patient has had no fever, nor has she been jaundiced, although the conjunctivæ have a subicteric tinge at present.

The patient has seven children living and well. One baby was stillborn at seven months: no history could be obtained of sore throat, rash, alopecia, or nocturnal headaches. The pupils react to both light and accommodation; the Romberg sign is negative; both knee-jerks are present.

COMMENTS

Dr. Murphy (January 27, 1916): Notwithstanding the stillbirth there is nothing to confirm the suspicion of lues, or that these pains are the girdle-pains of tabes—the common lesion for which celiotomies are performed unnecessarily under the mistaken diagnosis of gastric or duodenal ulcer, gall-stones, or appendicitis. In some cases of tabes one has the clinical history to rely upon, but the cases which are hard to differentiate are those in which the inaugural symptoms are gastric crises. One may have any of the abdominal lesions mentioned and still have a plus von Wassermann reaction complicating the diagnosis, but in the majority of cases the latter is easy once tabes is suspected.

USELESS SURGICAL OPERATIONS IN 1000 CASES OF TABES DORSALIS.
—(*Nuzum.*)

Surgeon's Diagnosis	Number of Operations
Gastric ulcer	19
Gall-stones or cholecystitis	19
Appendicitis	18
Salpingitis	13
Exploratory laparotomy	9
Renal calculi	7
Postoperative adhesions	7
Tumor of cauda equina	1
Sciatica (nerve stretching)	1
Meningocele	1
Ectopic gestation	1
Peritonitis	1
Total number of operations	97 (9.7 per cent.)

This patient presented no history of a lesion in the right upper abdominal quadrant previous to the gall-stone pain which occurred just one month ago, and the two major attacks in the interim were typical in the pain radiating toward the shoulder and followed by nausea and vomiting and sensitiveness in the right hypochondrium: on admission to hospital she was still somewhat sore, but not so sensitive as one might expect from a recent attack. She had, however, on examination an apparently normally flexible liver-margin; but a little to the right of the umbilical notch a hard nodule the size of the thumb projects below the edge of the liver: the latter is flexible above and below the nodule. The patient's history of typhoid fever suggests an etiologic factor in the production of gall-stones, and from our observations it is the commonest cause; appendicitis, also, is an etiologic factor.

The nature of this hard nodule is conjectural: Is it a single stone lodged in the fundus of the gall-bladder or in a diverticulum? Is it the gall-bladder filled with stones? Or is it a neoplasm? Cancer of the fundus of the gall-bladder is, we believe, the sequence of frequent irritations; but cancer of the gall-bladder is such a rare disease in proportion to the number of gall-stone cases that if stones are the etiologic factor it is surprising that they do not produce this evil result more frequently.

OPERATION

[Celiotomy through outer margin of right rectus muscle above navel: wound-edges retracted.] . . . The nodule which we felt is the gall-bladder, enlarged, hard as wood, and full of gall-stones. The liver above the gall-bladder is as hard as wood and the regional lymph-nodes are enlarged and hard. The stomach and other abdominal viscera are uninvolved. In view of these cancerous findings it would be futile to remove the gall-bladder or perform any other type of radical operation. [Specimen removed from liver for pathologic examination; instruments and sponges accounted for; wound closed without drainage.]

POSTOPERATIVE COMMENTS

There is nothing in this patient's history to lead one to believe that the gall-stones had existed for such a long period of time: not one gall-stone case out of one hundred in which the stones have been confined to the gall-bladder shows anything in the history that indicates the presence of stones. When cancer involves the fundus of an organ, there are few or no manifestations of its presence; but when it involves the neck or outlet, the opposite obtains.

A case somewhat similar to ours in clinical history and operative findings, but which proved to be primary *sarcoma of the gall-bladder*, was reported by Carson and Smith (*Annals of Surgery*, December, 1915, 688): cholecystectomy was performed, and the part of the liver invaded with tumor tissue was removed with the gall-bladder. The patient died four days after operation.

This is the ninth well-authenticated case of primary sarcoma of the gall-bladder which has been reported, although this disease may be of more frequent occurrence. In one of Landsteiner's cases there existed in the gall-bladder, besides the sarcoma, an epithelioma which had arisen as a metaplasia of the mucous membrane and was invading the deeper structures of the wall. There is a curious tendency in some of the tumors to grow in the direction of the cystic duct. Invasion of the substance of the liver is common, even in the case of small tumors: the involvement of the liver by an extension of the growth from the gall-bladder may become very great. Gall-stones were found in all cases except one.

Postscript.—There was primary union. The patient progressed uneventfully to recovery.

(For bibliography of cases of biliary calculi previously published in the CLINICS see vol. iv, December, 1915, 1143.)

PYLORIC OBSTRUCTION FROM CICATRICIAL BAND—RELEASE; OBLITERATIVE APPENDICITIS—APPENDECTOMY

Summary: Clinical history of patient; comments—analysis of history; the diagnosis of juxta-pyloric ulcer; order of symptoms in duodenal ulcer; operation—a cicatricial band found obstructing pylorus and angulating stomach: band dissevered; no ulcer found; obliterative appendicitis—appendix removed.

CLINICAL HISTORY OF PATIENT

A MALE, twenty-nine years of age, was admitted to Mercy Hospital November 18, 1915. The family and past histories are negative.

Two years previously, in December, 1913, the patient began to suffer from belching of gas and regurgitation of sour material within two or three hours—and often immediately—after eating. There were pain and occasionally nausea, but rarely was there vomiting. He was troubled throughout the winter, but improved in the spring and remained fairly well throughout the summer over a period of six months, when the stomach distress returned: it has persisted up to the present time.

The belching and regurgitation have been becoming gradually worse, while within recent months the pain has given way to a severe gnawing and burning discomfort in the stomach, which is most marked from two to three hours after meals: this discomfort affects also the esophagus and pharynx; there is neither sharp pain nor vomiting. Heartburn occurs from two to three hours after each meal, and often awakens him at night—as late as 4 or 5 A. M.: it is relieved by eating, but returns from two to three hours after the relief-food is ingested.

Blood has not been noticed in the stools. There are occasional attacks of diarrhea, which last from a day to a day and a half. The patient has not been jaundiced: he has not lost weight.

COMMENTS

Dr. Murphy (November 20, 1915): This patient's malady began in December and continued throughout the winter: in the spring it disappeared and remained quiescent until the next fall, when it returned, and since then it has continued up to the present time. He has symptoms of distress after meals, followed by food-relief. The disease comes on in the fall, is better in the summer, becomes worse again in the winter, and finally becomes continuous: there is the presence of a little blood in the gastric lavage. Has he duodenal ulcer, gastric ulcer, chronic (obliterative) appendicitis, or gall-bladder disease?

In all these cases one must make his diagnosis on the patient's story, rather than on the physical examination, for the latter always leaves an element of uncertainty as to the diagnosis. While patients frequently relate the same story of the same lesion, yet the history is fairly uniform if you keep asking it over and over again. In many cases of duodenal ulcer the history is fairly clear and accurate—so accurate, indeed, that one can establish the diagnosis on the basis of the history, particularly if he has had the patient under observation for a long time.

I notice sitting here in the arena Dr. Torpey, who lives in a small town in Iowa of 2800 inhabitants: at different times he has referred cases of gastric and duodenal ulcer to me,—I think five within a very short time,—and in each case he made a positive diagnosis as to whether it was gastric or duodenal ulcer, and in every case the diagnosis was confirmed at operation. The fact that five cases occurred in such a comparatively short time in one physician's experience alone in a small town of 2800 inhabitants emphasizes the frequency of juxta-pyloric ulcer. An enormous percentage of these cases is overlooked and diagnosed as hyperacidity: one of the handicaps in an operating clinic is that we must establish the diagnosis from the patient's history, instead of from seeing him in an acute attack, when it is comparatively easier to make the differential diagnosis.

This is not a clean-cut case, but one in which a large interrogation point should be placed after the preoperative diagnosis. The usual order of symptoms in duodenal ulcer is, first, that the greatest pain comes on from two to four hours after meals; secondly, belching from the large quantity of gas which gathers; thirdly, temporary food-relief; that is, upon the intake of additional food during the seizure. In this case food-relief was not a striking symptom, since the patient had not carefully observed it; however, by merely asking him on what occasions he took food-material for relief and what he took, we were able to draw the conclusion that he had some kind of food-relief: he did not give the clear history of food-relief which so many patients with duodenal ulcer give, but he gave the symptoms of gastric retention, which is confirmed by skiagram.

OPERATION

[Celiotomy incision placed through outer portion of right rectus muscle above level of navel: the muscle was not divided, but was drawn inward; wound-edges retracted and exploration begun.] . . . I am examining first the pyloric zone of the stomach, because 84 per cent. of all cases of gastric ulcer involve that zone. There is hyperplasia of the muscular tunic of the stomach, showing that there has been an obstruction to the outlet. There is no palpable evidence of ulcer at the pylorus: this indicates that at least it is not the chronic indurative type of ulcer that exists in the stomach. The stomach is suspended at a sharp angle, which is due to a sharp band binding it at the outlet: this band passes up to the transverse fissure of the liver, and is so strong that the patient may be lifted from the table by it. [Dissevers the band.] . . . Now the stomach is free and can be brought up into the field without any difficulty. The duodenum is dilated beyond the usual degree, but shows no scar on its dorsum, which is the commonest site of duodenal ulcer. Neither a gastric nor a duodenal ulcer is present to account for the cicatricial band. The gall-bladder is fairly readily compressible, contains no stones, and is free from adhesions.

It remains to inspect the appendiceal zone. . . . The ileum is brought into the field without traction, showing the absence of a Lane kink. On dislodging the caput coli, we find the appendix passing through a slit in the mesoappendix and buried in a pocket behind the peritoneum: its lumen is narrowed at its base, and the organ is infiltrated at its end. [Appendix removed by usual technic; instruments and sponges accounted for; peritoneum closed by making ectropion of edges; posterior sheath of rectus sutured; rectus muscle allowed to fall back into place; anterior sheath accurately sutured; skin closed without insertion of drainage.] . . . The atypic history justifies the atypic findings.

Postscript (*January 11, 1916*).—The patient has had no further gastric distress and is feeling fine.

ULCER OF DUODENUM AND OF JEJUNUM—ANTERIOR GASTROJEJUNOSTOMY BY OBLONG BUTTON METHOD

Summary: Clinical history of patient; comments—analysis of history; operation—exploration and findings; selection of type of anastomosis depends upon pathologic findings; antecolic (anterior) gastrojejunostomy performed with oblong button.

CLINICAL HISTORY OF PATIENT

A MALE, sixty-two years of age, was first admitted to Mercy Hospital January 29, 1915. The family and past histories are negative.

During the past fifteen years the patient has suffered from "dyspepsia," which was characterized by a sensation of heaviness and burning in the throat, belching of gas, nausea and vomiting, and constipation.

During the past four years this "dyspepsia" has been worse. The patient has pain from one to three hours after eating, which is relieved by belching; the nausea and vomiting come on from two to three hours after meals, and vomiting of sour material gives relief: gastric lavage also gives relief. At no time has the patient vomited blood nor passed blood in the stools. These attacks occurred monthly during this period.

On January 12, 1915, before eating supper the patient had a sensation of distress in the epigastrium, which twenty minutes later was followed by pain, then nausea and vomiting: he vomited everything he had eaten for two days; the vomiting lasted four hours, with intermissions of from five to ten minutes. The pain was dull in character, but required a hypodermic injection of morphin: it lasted throughout the night, until the anodyne was administered. Two days later, after partaking of a light meal for the first time, the patient vomited twenty minutes later. The next day he ingested some oatmeal, and four hours later some barley-water; three hours after taking the latter he vomited both oatmeal and barley-water. He has not been able to eat anything since, and even a little water makes him vomit immediately. He has never passed a stone, gravel, or blood in the urine. He has never been jaundiced, nor has he had colicky pains. The stools are normal.

The patient became rapidly emaciated, declined operation, and was put on a course of medical treatment for duodenal ulcer. He regained his health and almost his full weight, and was discharged from hospital March 12, 1915—a striking example of a medical cure.

The second admission was on December 19, 1915. After the previous discharge from hospital the patient remained free from symptoms for six months, when there appeared loss of appetite and sensation of distress in epigastrium after meals, eructations of sour material, and loss of weight. These symptoms continued until the latter part of September, when there began a burning sensation in the abdomen twenty minutes to one hour after eating, and eructations of sour material, which usually relieved the discomfort.

On October 1st the patient was awakened about 12.30 A. M. from a sound sleep with a scalding pain in the epigastrium: he induced vomiting, which brought forth a large amount of greenish fluid and food ingested at breakfast and at the other two meals; the vomiting relieved the pain.

After October 1st the pain recurred between 12 and 12.30 every night. On December 15th—four days before admission—the patient was awakened about 10 o'clock in the evening with a sharp cramp in the upper abdomen, which extended entirely across, but no severer on the right side than on the left: the pain lasted about twenty minutes, when the patient was given bicarbonate of soda, which induced vomiting and relieved him. There was considerable soreness all over the upper abdomen for ten days after this attack. The next day the bowel movements were black and tarry, but by the end of two days the stools had regained their normal color: during this time the patient did not faint or feel dizzy, nor did he have palpitation of the heart or black spots before his eyes. There was no chill or fever or vomiting of blood.

On account of pain and vomiting caused by eating, the patient gradually became weaker from the lack of food: he lost ten pounds between October 15th and the time of admission.

On December 19th, at 10 o'clock in the morning,—shortly after admission to hospital,—the patient vomited nearly ½ a pint of coffee-colored material: this was sent to the laboratory and proved to be blood.

Examination by Dr. Murphy (*December 10, 1915*).—No abdominal tumor is palpable, nor is there any tenderness of the abdomen. Skiagrams reveal obstruction to the outlet of the stomach and involvement of the gall-bladder. The patient was advised to be operated upon immediately, but preferred to postpone operation until after the holidays.

COMMENTS

Dr. Murphy (January 31, 1916): The patient gives a history of gastric disturbances extending over a period of fifteen years, with periodic attacks coming on about once a month. With the attacks he had pain in the epigastrium coming on from one to three hours after meals: the pain was relieved by vomiting, but not relieved by the further intake of food. One year ago he had an attack of acute epigastric pain, soreness in epigastrium, and black, tarry stools, but no hematemesis.

In December, 1915, he had the evidence of near-perforation in his upper abdomen, with nausea and continued soreness for a long period of time after the acute pain.

After leaving hospital on December 10th he was home just one week when he was taken with another severe attack, and was readmitted to hospital December 19th, since which time he has been under preparatory medical treatment.

Our diagnosis is duodenal ulcer with attempts at perforation and sequential adhesions, etc.

OPERATION

[Celiotomy incision placed through right rectus muscle above level of navel; wound-edges retracted.] . . . As we explore the upper abdomen we find that the gall-bladder empties easily, but is adherent to the duodenum. The under surface of the arch of the duodenum is involved in an extensive inflammatory induration, which indicates the site of a duodenal ulcer. In chronic ulcers in this situation the pylorus forms the Great Divide: if the ulcer is on the gastric side of the pylorus, it is liable to undergo malignant degeneration in a certain percentage of cases; while if on the duodenal side, such a liability is rarely manifest. . . . There is another ulcer in the first portion of the jejunum, causing slight stenosis: this is but the second ulcer which I have seen in this situation. . . . The head of the pancreas is not thickened. There are infiltration and a chronic inflammatory condition over the whole surface of the pancreas, and much thickening and shortening of the transverse mesocolon from scar-tissue, showing the result of peritoneal infection at the time of attempted perforation of the ulcer.

From study of the living pathology it is evident that the ulcerous condition has been present for a long time and has been getting worse. The proximal ulcer extends from the pyloric zone out into the duodenum: it had attempted to perforate, but adhesions formed from repeated attacks of peritonitis, leaving scar tissue, which represented the efforts of nature to keep the ulcer from opening into the free peritoneal cavity. These very adhesions, however, are so situated as to prevent our performing gastrojejunostomy by the retrocolic or posterior route: we shall, therefore, employ the antecolic, or anterior route, with a loop of from 18 to 20 inches in length, using our oblong button for the anastomosis.

[Performs gastrojejunostomy in accordance with technic already described in vol. v, February, 1916, 24.]

Postscript (*February 27th*).—The stitches were removed on the fourteenth day: there was complete primary union. The patient passed the button on the seventeenth day. On discharge from hospital he was in splendid condition.

April 3, 1916.—The patient reports that he is much improved, and that he feels quite well and looks well. His appetite is fine, and he sleeps soundly. Weight, 168½ pounds.

[The bibliography of duodenal ulcer was published in this volume, February number, page 26.]

OBTURATION ILEUS—RELEASE BY DISSEVERANCE OF BAND—TALK ON INTESTINAL OBSTRUCTION

Summary: **Clinical history of patient; emergency operation—band obstructing small intestine was found and dissevered; postoperative comments—nature of the lesion; postscript—talk on intestinal obstruction.**

CLINICAL HISTORY OF PATIENT

A FEMALE, twenty-four years of age, was admitted to Mercy Hospital January 10, 1916. The family history reveals that the patient's mother died from "perforation of the bowel" when sixty-nine years of age, and that one brother died from pulmonary tuberculosis.

Nearly five years ago, in May, 1911, the patient complained of a dull ache in the pelvis, especially on the left side: she was not menstruating at this time. Soon there began slight afternoon fever, which quickly led to a continuous fever of from 101° to 102° F.

On May 28, 1911, the patient was attacked by severe, excruciating abdominal pain which was diffuse throughout the abdomen, but most marked below the navel. On examination the abdomen was found distended and very tender; there was fever of 103°–104° F. She was operated upon that same evening: a pus-tube was removed and drainage instituted. The drainage-tubes were removed five days later, on June 2d, and the wound healed within fifteen days.

Since the operation the patient has maintained a fairly good state of health. There was a tendency toward constipation, which was warded off by cathartics. She suffered from gas-discomfort in the region of the sigmoid flexure.

Sixteen days previous to admission, on December 25, 1915, the patient was attacked by violent generalized abdominal cramps, which were wave-like and recurred two or three times a minute, and felt as though the bowels were trying to overcome an obstruction. There was no vomiting or fever. The abdomen was tense, tender, and distended with gas. The pain was severe enough to require an anodyne, which afforded relief. There was no bowel movement, and no gas was passed.

The next day the patient was given a high enema, and very little feces and gas came away. The patient took and retained some nourishment. The pains continued and required two more doses of morphin for relief. The stomach was washed out, but the abdomen remained distended and tense. This condition continued for about two weeks: high enemata were administered daily and resulted in some small amounts of feces and flatus.

On January 7th the patient was feeling somewhat better. An enema was administered and brought away considerable gas and feces.

On January 8th the pains returned—this time severer than at any previous time. In the evening the patient vomited a small amount of greenish slime: the next morning the physician washed her stomach out and recovered fecal matter. She was admitted to hospital the next day.

Examination by Dr. Murphy (January 10th, 12 M.).—The patient's skin is cyanotic. Stomach washings reveal about two ounces of very offensive material. On superficial percussion there is slight flatness in the right iliac fossa: elsewhere throughout the abdomen there is great resonance; peristaltic waves can be seen passing along the bowel, culminating in the right iliac fossa, under the scar of the previous operation.

The stethoscope revealed stormy borborygmus, with the explosions occurring at the end of each wave just beneath the scar in the right iliac fossa. This is a very important sign in the localization of the point of obstruction previous to the operation. On piano percussion small zones of flatness were outlined beneath the scar. These show the von Zeugermann-Teufel areas of shortening so characteristic of mechanic obstruction.

Diagnosis: Mechanic ileus of the obturation type; otherwise this patient would have been dead long before this time, as it is fifteen days since the initial obstruction was noted.

OPERATION

DR. MURPHY (January 10th, 2 P. M.): After dividing the right rectus muscle and its sheaths there is noted vaulting forward of the peritoneum, and upon incision of the latter free flüid escapes, probably accounting for the flatness. The coils of small bowel are greatly distended, as was found upon physical examination before operation. The cause of this distention is, as you see, a band due to intestinal adhesions, under which passed a coil of small bowel: this coil was not completely obstructed, nor was it gangrenous; it showed, however, a deep depression from the long-continued pressure of the band. [Reëstablishes lumen of compressed portion of bowel by dissevering band; with a catgut stitch tucks in raw surface of bowel due to pressure of band; sponges and instruments accounted for and wound closed without drainage.] . . .

POSTOPERATIVE COMMENTS

This was a case of obturation ileus, thereby accounting for the fact that the patient was able to live so long, and was in complete accord with her physician's diagnosis of "incomplete obstruction." There was great hyperplasia of the small intestine above the point of obstruction, showing the long period the bowel had been under tension trying to force the intestinal contents through the point of mechanic obstruction.

The mortality of acute intestinal obstruction continues to be colossal and appalling. The able paper recently written by that master teacher and brilliant operator, Dr. John B. Deaver, in conjunction with Dr. George G. Ross (*Annals of Surgery*, February, 1915, 198), accentuates this, as it shows that there is approximately a 40 per cent. mortality for acute mechanic intestinal obstruction, including both the internal and the external type. In this calculation of 40 per cent. mortality, 56 per cent. were strangulated hernia, namely, external obstructions, so that approximately 56 per cent. at least should have been recognized early and should therefore have a mortality of not more than 2 or 3 per cent., while the other 44 per cent., though more difficult of recognition, as a rule, have symptoms that are clean cut and pronounced, and a diagnostician of average information and experience should recognize them, and when recognized as mechanic obstructions, a man of mediocre information should insist upon an immediate operative procedure.

McGlannan's experience with massive strangulated hernia (see p. 452) shows that the mortality rate is nearly 50 per cent., as against 26 per cent. in other forms of strangulated hernia, corresponding with Deaver's.

When, in a clinic by such a master as Deaver, the mortality of intestinal obstruction still continues high, it must be admitted that the mortality is not an operative mortality, but a procrastination mortality—a mortality due to either failure or delay in making and acting upon a diagnosis. It seems to me that the profession must raise its voice to a higher pitch in condemning this practice in the future than it has in the past. There is no longer an excuse for this mortality. It has not materially improved in thirty-five years, notwithstanding the great improvement in diagnostic aids and in the technic of operative procedures—a rather sad commentary on the pace of general advancement of the medical profession.

The classification of ileus, the chronologic order of symptoms, the physical signs in the various types of dynamic, adynamic, and mechanic ileus, seem so plain that they should be comprehended and mastered by every general practitioner of medicine. The clinical story makes up four-fifths of the information; the physical findings, laboratory information, etc., make up the remaining fifth. It is, however, a bedside proposition, better, an immediate bedside proposition, where the elaborate laboratory and machine diagnostic aids cannot be made readily available. Therefore, clinical experience and analysis of clinical symptoms and signs must always constitute the greatest factors in arriving at a positive differential diagnosis.

If one could withhold the abuse of the hypodermic in these cases, I am sure that the greatest barrier to timely differential diagnosis would be overcome. But that medical curse—the hypodermic—is so easily available and puts the patient in such comfort and ease with himself that his pathology ceases longer to cry aloud for relief, and he is lulled to a hasty euthanasia. A law that the hypodermic injection should not be given in acute abdominal lesions until the diagnosis is made is one that should be stamped on the coverlid of every hypodermic case. The public needs some instruction in this particular, as they cry out for the patient's immediate relief, rather than for a diagnosis, and then an intelligent and safe "relief" of the patient.

TABLE SHOWING ETIOLOGY OF 276 CONSECUTIVE CASES OF ACUTE INTESTINAL OBSTRUCTION ADMITTED TO THE GERMAN HOSPITAL, PHILADELPHIA, DURING THE DECADE ENDING 1913 (DEAVER AND ROSS)

Postoperative adhesions		81 cases
Post-inflammatory adhesions		16 "
Strangulated hernia		156 "
Inguinal	77	
Femoral	50	
Umbilical	21	
Ventral	7	
Subdiaphragmatic	1	
Carcinoma of sigmoid		8 "
Volvulus		5 "
Fecal impaction		3 "
Intussusception		2 "
Adynamic ileus		2 "
Congenital bands		1 case
Cause not known or not recorded		2 cases

Postscript (*March 2, 1916*).—The patient made an uneventful recovery and left hospital in usual time. She had gastric lavage every three hours following the operation, until no more fluid accumulated in the stomach: she also received proctoclysis of 1½ pints of sodium bicarbonate, 6 : 1000, every three hours. The following day she passed flatus, and the second day, feces. She was not given a cathartic at any time.

A cathartic immediately following an operation for intestinal obstruction is always a source of danger, and is not indicated. The intestine needs no additional cathartic irritation. If the obstruction has been of long duration, a full dose of pituitrin should be administered and repeated every three hours until peristalsis is reëstablished. (For further observations upon the use of pituitrin in paralytic ileus consult article by Gibson in *Annals of Surgery* for April, 1916, 447.)

(For a talk on the varieties, symptoms, and treatment of ileus, with illustrative cases, consult vol. iii, August, 1914, 617–661.)

POSTOPERATIVE VENTRAL HERNIA (THREE CASES). STONE IN CYSTIC DUCT—CHOLECYSTOSTOMY (CASE III)

Summary: Case I.—Clinical history of patient; comments—review of surgical history; necessity of restricting use of morphin; operation—extensive adhesions encountered; imbrication-operation performed; postoperative comments—pulmonary edema as a cause of death; prevention and treatment of pulmonary edema.

Case II.—Clinical history of patient; comments—exploration of abdomen when operating for incisional hernia; the high mortality of umbilical and ventral hernia: its causes; operation—dense adhesions encountered in lower abdomen; imbrication-operation performed; postoperative comments—effect of hot oil on adhesion-formation.

Case III.—Clinical history of patient; comments—adhesion-formation in incisional hernia; importance of early operation; operation—stone in cystic duct; cholecystostomy; imbrication of flaps.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-five years of age, was admitted to Mercy Hospital June 3, 1915. The family history reveals that the patient's father died from carcinoma of the stomach. The patient contracted gonorrhea thirteen years, and a chancre twelve years, previously: he received modern luetic therapy.

In 1898 the patient suffered an attack of fever, jaundice, and constipation, and was laid up in bed for one week. For many years he was constipated and had attacks of abdominal pain in the umbilical region, which often confined him to bed for two or three days at a time.

In 1911 the patient was operated upon for appendicitis: the appendix was eight inches long and was removed. For some months after the operation he felt fairly well and was able to attend to his work.

In 1912 the pain in the abdomen recurred, but was moderate in severity, though often continuing for days at a time: it was not localized. The patient was usually more comfortable when the stomach contained food: there was occasionally food-relief.

In July, 1913, the patient was operated upon for gall-stones, but none was found: the gall-bladder was drained for two or three weeks, but without relief.

Since the second operation the abdominal pain has come on intermittently: it is not associated with chills or fever; the attacks are often so severe that morphin is required for relief. Vomiting is associated with the severer attacks alone. There is no blood in the stools.

During the last year or two the patient has been an invalid: he becomes very tired when walking or standing and has severe temporal and occipital headaches, usually in the morning upon awakening.

Romberg's sign is negative. The pupils react to light. The patellar reflexes are greatly exaggerated. The Wassermann test is negative. The urine showed hyaline casts.

The appendectomy scar is firm and does not protrude. There is an enormous protrusion at the site of the gall-bladder operation: the nerve-endings in the scar are very sensitive. Skiagram reveals elongation of the stomach to the right, with apparent contraction of the pyloric zone for a distance of three inches toward the fundus. There is no evidence of obstruction of the large intestine.

COMMENTS

Dr. Murphy (June 5, 1915): The frequency with which the anodyne was administered is not stated in the history: in the heavy expression, the drooping mouth, and the glaring eyes, his is the classic facies of the drug *habitué*.

The patient had originally some trouble in his abdomen: whether or not it was appendicitis no one can say, because one can obtain no corroborative evidence of that malady from him. The appendix was presumably removed on account of pain in the right side of the abdomen and constipation. Next the gall-bladder was operated upon, but without relief: following this operation there was an incisional hernia, seven or eight inches in length. We shall explore the abdomen, for we haven't the slightest idea of what is causing the pain, nor are we convinced that he has *real* pain.

This is a disagreeable case, for the patient is a drug *habitué* of the doctor's making: I speak of it as a professional matter. Unfortunately, too many such cases are of our making. The primary dose of morphin is a crime wherever there is a lesion producing recurrent pain: once you start it, you cannot get away from it, and if you do not give it to the patient some one else will. A dose of morphin administered to relieve the pain of acute inflammatory trouble, if given after the diagnosis has been made, is an entirely different matter; but the morphin should never be given in such a case *until after the diagnosis has been established.* Experimental surgery has shown that morphin is a real antiphlogistic and subdues inflammatory action.

OPERATION

[The abdominal cavity was entered through the gall-bladder hernial scar: exploration revealed very extensive adhesions, but no distended coils of intestine or other evidence of obstruction to the digestive tube as a sequence of the adhesions; a small adhesion between the pylorus and the infundibulum of the gall-bladder; no evidence of ulcer at the pyloric zone of the stomach, no evidence of gastric dilatation, and no hernia at the site of the appendectomy scar. After freeing the small and large intestines about the hernial zone, the great omentum was folded upward to cover the whole regional peritoneum and sutured in the gastrohepatic fossa, so as to prevent adhesion of the stomach and intestines to the under surface of the liver, or to the parietal peritoneum, and the incision was closed by the longitudinal overlapping flap method, which resulted in great diminution of the girth of the abdomen. After closing the peritoneal cavity the field was sponged off with 5 per cent. phenol, and the skin was closed with catgut sutures. A rubber drainage-tube was inserted into the subcutaneous wound to provide for the escape of oozing of blood during the first forty-eight hours, thereby preventing hematoma-formation.]

POSTOPERATIVE COMMENTS

The postoperative mortality of cases of large incisional and massive umbilical herniæ is apt to be comparatively high, from the development of pulmonary edema. When put back to bed, the patient is usually in good condition, but difficulty in breathing appears and becomes more and more marked; a slight irritating cough develops, cyanosis begins, and then foamy material bubbles out of the mouth, becoming bloody.

In my childhood days I heard tales of the lumbermen in northern Wisconsin—of how, after riding from twelve to twenty-four hours a day with the temperature down to 30° or 40° below zero, some of these men came into the house, sat down by the stove, went to sleep, and never awoke. The cause of death in these cases was pulmonary edema from the sudden entrance into a warm room after the long exposure to cold.

The first case of pulmonary edema I saw after graduating in medicine was in a patient who had Bright's disease. After coming in from a sleigh-ride this man sat down by the stove, began to cough a little, and developed increasing difficulty in breathing. I saw him probably one hour after the onset of the symptoms: he became more and more cyanotic every few minutes, and although he was perfectly rational, yet I notified his brother that he would die very quickly, and he died two hours later.

We had been performing hernia operations of all types for twenty years before meeting with a case of pulmonary edema, and while that patient died, since then we have had three other cases, and all three recovered.

This patient will be placed in bed with the foot of the bed elevated from 8 to 15 inches. He will be given atropin,—$\frac{1}{120}$ grain every four hours,—and if pulmonary edema appears, the atropin will be pushed in doses of $\frac{1}{50}$ grain every half-hour until the physiologic limit is reached, and to the atropin, morphin and adrenalin will be added: we believe that adrenalin has had some influence in aiding the recovery of our later cases.

The only explanation which I have offered for the development of pulmonary edema is a deficiency in the action of the diaphragm muscle in breathing. The cause of death lies in the fact that the diaphragm does not act promptly against the increased intra-abdominal tension due to the reduction of the hernia and approximation of the wound-edges, so that respirations become shorter and shorter. Many years ago, in 1898, we showed conclusively that the diaphragm is the piston of respiration, the other muscles being accessory only, and that anything which interferes with the diaphragm interferes also with the real piston of respiration. It is exactly like the piston of an engine: it produces a minus pressure by its contraction.

Postscript.—The patient made an uneventful recovery.

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CASE II

CLINICAL HISTORY OF PATIENT

A FEMALE, thirty-three years of age, was admitted to Mercy Hospital June 15, 1915. The family and previous histories are negative.

Sixteen months previous to admission the patient underwent an abdominal operation, but she does not know what the nature of the operation was. She has felt weak since the operation. She has never been jaundiced.

Examination by Dr. Murphy (May 11, 1915).—Tenderness is elicited by perpendicular finger-percussion in the gall-bladder zone. The perineum has been well repaired. Vaginal examination reveals a small cyst in the left ovary, which is not, however, large enough to require an operation. At the site of the operative scar there is separation of the aponeurosis with a hernial protrusion, and there is extensive diastasis of the recti muscles.

COMMENTS

DR. MURPHY (June 16, 1915): In addition to the large incisional hernia, the patient states that she has the same pain which she had before the operation. In the presence of such a hernia with its inevitable adhesions, not only is a second operation unpleasant, but the picture of the average disease in the

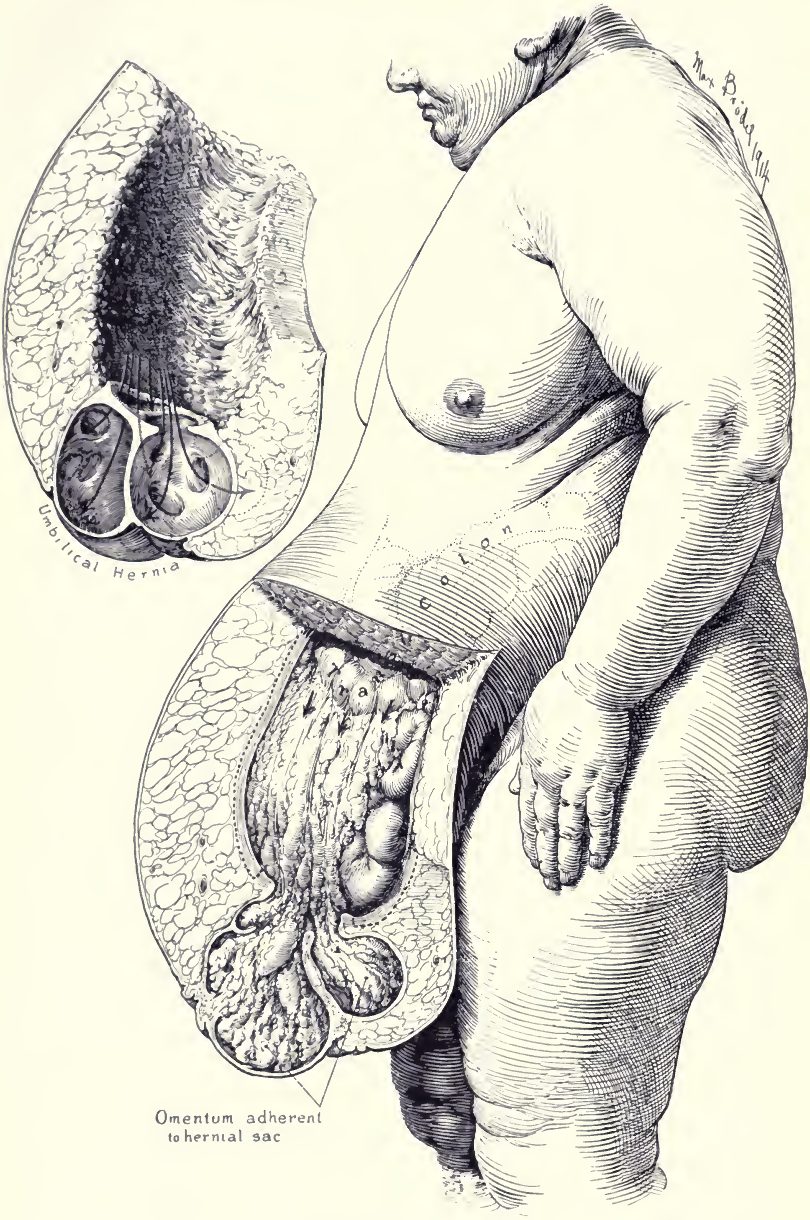

Fig. 83.—(Cullen.)

abdomen is blurred by the adhesions: nevertheless, owing to the tenderness on perpendicular finger-percussion over the gall-bladder, we are going to examine the gall-bladder and the rest of the abdomen so as to relieve her of the cause of the pain as well as of the hernia.

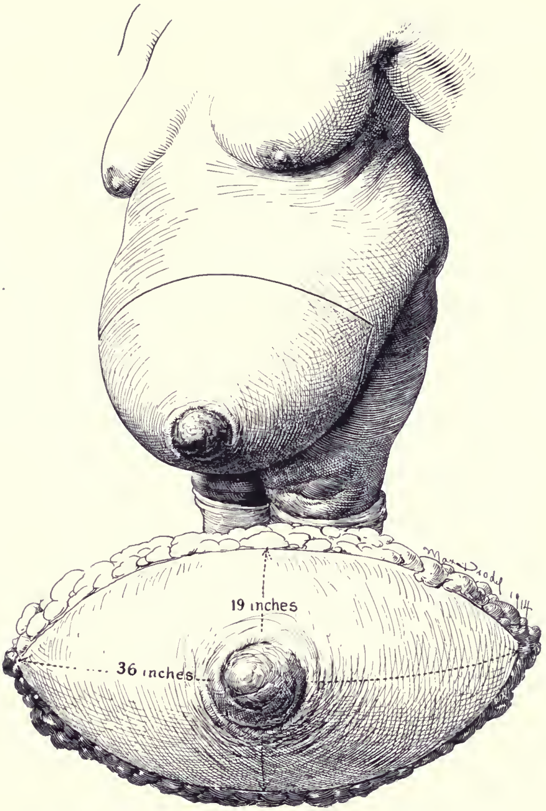

Fig. 84.—(Cullen.)

[Refers to case of hernia described above (p. 445).] Since we operated upon that patient an article upon the subject of massive umbilical and ventral hernia by McGlannan, of Baltimore, has appeared (*Surg., Gyn., and Obstet.*, June, 1915, 700–704). Comparing the mortality of these varieties with that of inguinal hernia, McGlannan found that in a series of 1900 non-strangulated inguinal hernias there were but 4 deaths—a mortality rate of a little over 0.2 per cent.; while in a series of 197 umbilical and ventral hernias operated upon by the same group of surgeons during the same period of time, there were 6 deaths—about 3 per cent. In this latter series there were 46 massive hernias with 3 deaths—about 6 per cent.; and when strangulation complicates the condition, the mortality rate in the massive hernias reaches *nearly 50 per cent., as against 26 per cent. in all other forms*

Massive umbilical hernias usually occur in the very corpulent (Figs. 83 and 84), and in those well advanced in years. The mortality is due to lesions of the cardiovascular and renal systems (Bright's disease, myocarditis, arteriosclerosis, etc.) or to pulmonary edema (see p. 448).

After the operation this patient remained in bed for two weeks, and the wound healed by primary union, without suppuration. We do not hold the surgeon responsible for the development of this hernia, because a postoperative hernia may form despite what one does to prevent it.

OPERATION

[Exploration revealed that the gall-bladder was compressible and free from adhesions and stones; that the pyloric zone of the stomach was free from adhesions; and that dense, fibrous adhesions prevailed throughout the lower half of the abdomen, the uterus being covered by a mass of adhesions. The adhesions were freed from the anterior abdominal wall until the hernia was exposed throughout its length: at one place the large intestine entered a diverticulum in the sac. After freeing the adhesions and reducing the hernia, the omentum was interposed and fixed between the intestines and the anterior abdominal wall; the operative field was swabbed with 5 per cent. phenol, and the wound was closed by an overlapping flap operation (as in Fig. 85), figure-of-8 silkworm-gut sutures being so inserted as to include both sheaths of the recti muscles and also obliterate the dead space between the anterior sheath and the skin. The skin-edges were approximated with horsehair. A fine drain was inserted beneath the superficial stitches, to be removed at the end of forty-eight hours.]

POSTOPERATIVE COMMENTS

I have seen this severe type of adhesions only in cases in which an attempt had been made to prevent their formation by pouring hot vaselin or paraffin into the peritoneal cavity: the densest and firmest adhesions I ever saw were the sequence of such a method of treatment.

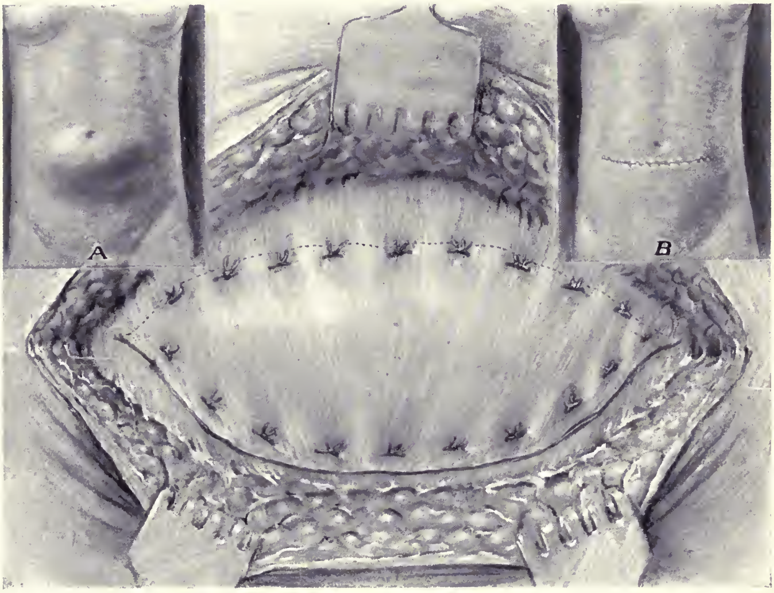

Fig. 85.—The transverse overlapping flap operation for ventral hernia. Dotted line indicates edge of lower flap.

Postscript (*March 7, 1916*).—Nine months have elapsed since the operation was performed. Examination today reveals a strong operative scar: there has been no recurrence of the hernia.

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CASE III

CLINICAL HISTORY OF PATIENT

A FEMALE, fifty-seven years of age, was admitted to Mercy Hospital September 13, 1915. The family and previous histories are negative.

Nine months ago, in December, 1914, the patient was operated upon for suppurative appendicitis: two weeks after the operation she had pain, chills and fever, and a pelvic abscess which discharged through the vagina. By the end of five days she had recovered, but noticed near the line of incision a bulging of the abdominal wall which, on coughing, protruded to about the size of a cucumber: this bulging was never present while the patient was at rest. There is no pain.

The patient has noticed an area of tenderness near the right costal margin, which has been more marked in the past year. She states that in August of each year she suffers from "bilious attacks"—no colic and no jaundice, but the skin becomes yellowish.

Examination by Dr. Murphy (September 2, 1915).—When the patient coughs, there is a marked anterior bulging of the abdominal wall, which extends above and below the line of the scar, but which is not sacculated. There is an oval mass in the gall-bladder notch of the liver: it moves synchronously with the liver, and from its oval shape feels like a gall-bladder under great tension, but palpation cannot be accurately carried out owing to the sensitiveness of the scar from the previous operation. Vaginal examination is negative.

COMMENTS

Dr. Murphy (September 15, 1915): We must anticipate adhesions in this case, first, because an abscess followed the removal of the appendix; secondly, because when incisional hernia has developed after an operation in an infected field the rule is that the intestine will be found adherent to the wall of the hernial sac.

Nearly two weeks ago we operated upon a patient in whom a large calculus had been left impacted in the ampulla of Vater following cholecystectomy performed elsewhere (case reported in vol. iv, December, 1915, 1137–1143). We removed the stone transduodenally. A long period of suppuration had followed the previous operation of cholecystectomy, and a large number of adhesions were present: it took us nearly one-half hour to find a free area of peritoneum anywhere in the abdomen, but we hope that we shall not encounter that condition here.

The presence of this hernia is very annoying to the patient. In addition to the bulging, there is paralysis of the rectus muscle on the inner side of the line of incision: the bulging itself extends higher than is usual after an operation for the removal of the appendix.

It is now only nine months since the original operation was performed—not a very long time. Given an incisional hernia, the shorter the period of time that has elapsed since the operation was performed, the less liable the patient is to suffer ill-effects from the operative reduction of the hernial contents into the abdominal cavity, with the consequent increase of intra-abdominal pressure.

OPERATION

[On opening the abdomen it was found that the bowel was not adherent to the anterior abdominal wall, but to the margin of the hernial sac, from which it was freed; the gall-bladder was enlarged, and a stone was impacted in the cystic duct; the stone was displaced from the cystic duct into the gall-bladder, and cholecystostomy was performed in the usual manner. After accounting for sponges and instruments the wound was closed by the imbrication-flap method. A wound-splint was applied to prevent transverse cutting and necrosis of the skin from the pressure of the silkworm-gut.]

Postscript (*October 5, 1915*).—It is now three weeks since the operation was performed: the wound healed by primary union, and the stitches were removed today. The drainage-tube was removed on the tenth day.

(For further comments upon postoperative ventral hernia, together with illustrated description of operative technic, consult vol. iii, August, 1914, 861–869.)

CARCINOMATOSIS OF PERITONEUM—EXPLORATORY OPERATION

Summary: Clinical history of patient; comments—differential diagnosis; operation—exploratory; postoperative comments—clinical course of the disease; cystadenomata *vs.* papillomata of peritoneum.

CLINICAL HISTORY OF PATIENT

A FEMALE, forty-five years of age, was admitted to Mercy Hospital February 21, 1916. The family and past histories are negative. Menstruation began when the patient was thirteen years of age, has always been regular, occurred every twenty-eight days, lasted from three to four days, and required one or two napkins a day: the latest period occurred one week ago. The July menstruation was accompanied by abdominal pain; the October menstruation was accompanied by abdominal pain and repeated vomiting; the January menstruation began while the patient was in bed with pleurisy, and lasted six days—two days longer than usual—and was accompanied by soreness in the lower abdomen, but there was no fever; the February menstruation was ten days late and lasted only three days.

On July 17, 1915,—seven months previous to admission,—the patient was attacked by severe pain in the right and left iliac regions, which did not radiate. Fever, nausea, vomiting, and tenderness were absent. The duration of the attack was one-half of an hour.

On July 20th a similar attack occurred and lasted the same length of time.

On October 1st the bowels became markedly constipated and were moved with great difficulty.

On November 26th dull pain began in the lower portion of the abdomen and at times radiated down the lower limbs. The pain lasted for the greater part of the day, and required a dose of morphin for relief. After each meal the patient was nauseated and vomited. She was tender over the lower portion of the abdomen—especially in the right iliac region. There was no fever.

Since November—now three months—pain and vomiting have occurred daily. The bowels have become more regular: they have contained neither blood nor mucus. There is no discomfort after eating. The patient has slowly lost in weight. The urine is negative. The heart-sounds are normal.

Examination by Dr. Murphy (February 21, 1916).—Bimanual palpation reveals a mass extending for three inches above the symphysis pubis, and situated more to the left of the midline. Occupying the pelvis—especially the right side—there is a hard tumor, which has pushed the uterus far down into the vagina, until its fundus rests just beneath the symphysis. This tumor has the resistance of a fibroid and cannot readily be displaced from the pelvis: the uterus is freely movable upon it, and the mass should be interpreted as an ovarian fibroid or a thick-walled ovarian cyst.

COMMENTS

Dr. Murphy (February 23, 1916): During the past three days we have operated upon three cases of ectopic gestation, and while that condition might come into mind, yet in this case the history is different; the uterus appears to be lifted out of the pelvis, and the latter contains a hard, resistant tumor. It is a question whether or not this pelvic tumor is associated with an impregnated uterus. The clinical history is not a clean-cut one of a fibroid of the uterus—unless it should be an extramural fibroid, which gives a peculiar clinical history.

The patient is forty-five years of age. Excepting the menstrual symptoms, this patient's history corresponds to that of ovarian fibroid: a dermoid tumor, too, could give rise to a similar history, but typical dermoid tumors of the pelvis do not impart such a wood-like feel, and, moreover, they are small. During the bimanual examination I was unable to displace the tumor from the pelvis: it seemed to be wedged in that cavity. The cervix rested anteriorly and was so soft that it suggested im-

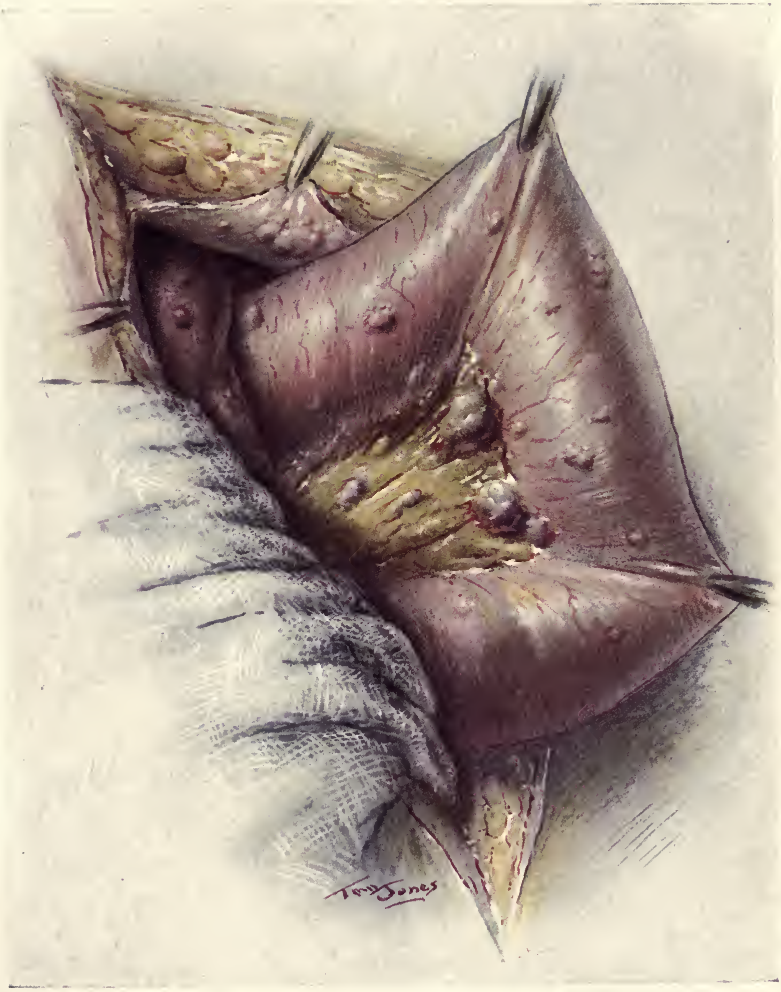

Fig. 86.—Carcinomatosis of peritoneum disseminating probably from rupture of adenocarcinomatous ovarian cyst.

pregnation of the uterus. There were free fluid in the peritoneal cavity and some irregular nodules, extending over to the left of the larger tumor mass, but connected with it.

OPERATION

[Upon opening the abdomen free fluid was found in the peritoneal cavity: the peritoneum itself was somewhat edematous, and an indurated mass the size of a ten-cent piece was excised from the parietal peritoneum; upon opening the peritoneal cavity more widely both parietal and visceral peritoneum were found studded with thousands of similar masses (Fig. 86), which resembled the miliary implants of a ruptured cystadenoma. A mass was found filling the pelvis: it was wood-like in hardness, round, smooth, and possibly an ovarian fibroma. On the left side of this a conglomerate massing of these neoplasms and tumors prevented palpation or inspection of the ovaries. An immediate microscopic examination was made, which showed it to be adenocarcinoma, probably from the rupture of an adenocarcinomatous ovarian cyst. The condition being inoperable, the sponges and instruments were accounted for, and then the incision was closed without drainage.]

POSTOPERATIVE COMMENTS

These cystadenomata are primarily semimalignant in character, but eventually become malignant: like malignant disease of the peritoneum, they tend to disseminate, not through the circulatory channels, but on the surface; eventually they spread over the entire peritoneum, the ascitic fluid increases in quantity, and finally the patient becomes enormously distended and dies from the effects of the parasitic tumors. In thus terminating life the disease behaves like malignant disease, but differs from the latter by metastasizing upon the surface alone.

Cystadenomata come and go very much like warts, and occasionally they are cured by therapeutic doses of *x*-rays and arsenic, as in the case of a patient from Indiana upon whom we operated six years ago, and who is now living and well.

These cystadenomata are closely related to papillomata of the peritoneum, and are implants of epithelial cells.

The prognosis in this case is not necessarily fatal, unless upon examination the specimen should prove to be carcinoma.

Pathologic Diagnosis.—Carcinoma of the peritoneal lymph-nodes. This was confirmed by hardened sections. Invasion and mitoses are present in all portions of the section.

Postscript.—The wound healed *per primam.* The patient will be treated by therapeutic doses of *x*-rays, sodium cacodylate, and Coley's serum.

The tumor continued to enlarge, notwithstanding the enormous doses of *x*-rays, administered through the Coolidge tube, and the colossal doses of sodium cacodylate given. She left hospital in seven weeks.

(A case of carcinomatosis of the peritoneum emanating from a carcinoma of the colon as a primary focus is reported in vol. iv, April, 1915, 277–87—illustration on p. 283.)

TUBERCULOUS PERITONITIS, ENTERITIS, LYMPHADENITIS—EXPLORATORY CELIOTOMY

Summary: Clinical history of patient; comments—construction of diagnosis; operation—tuberculous peritonitis, enteritis, and lymphadenitis—celiotomy with closure; postoperative comments—the pathology and curability of tuberculous enteritis and peritonitis.

CLINICAL HISTORY OF PATIENT

A FEMALE, thirty-eight years of age, was admitted to Mercy Hospital November 21, 1915. The family history is negative. During the past fifteen years the patient has suffered from "bronchitis." She was operated upon eight years ago for "tumor of the stomach"; one year ago for "appendicitis"; and eight months ago a third abdominal operation was performed, the nature of which she does not know (*vide infra*). She has not menstruated for the past two months.

Since the abdominal operation was performed eight months ago, shortly after the patient has ingested any variety of food cramps appear in the abdomen and left side of back, and there is a desire to defecate: after defecation the pain disappears for a time. In frequency the bowel-movements have averaged from ten to fifteen a day: they contain much undigested food. On certain days—especially when the patient is fasting—the bowels move but once. Every time the bowels move the urine "leaks": the latter contains "white strings."

During the past three months, when the abdominal cramps occur there is a "twisting" pain in the left foot at night: the foot still hurts when the patient walks very much.

The appetite is poor. The only discomfort after eating is due to the cramps. The patient eructates much gas, but there is neither nausea nor vomiting. She feels weak. Within the past eighteen months she has lost 39 pounds in weight: her present weight is 96 pounds.

Fever is associated with the severe abdominal cramps. Recently the patient has had night-sweats and a very slight cough, but no expectoration: there has also been some dyspnea.

Examination by Dr. Murphy (November 10, 1915).—Vaginal palpation reveals no infiltration in either fornix, nor any evidence of metastatic deposit in Douglas's pouch. The cervix is normal.

On bimanual examination there is found above the symphysis a sensitive mass which apparently involves the fundus of the uterus. Felt through the abdomen, the mass is hard and woodlike, but when felt through the vagina, no such ligneous sensation is imparted. The mass feels like the site of a short-circuiting intestinal anastomosis: it seems to be adherent to the uterus.

The feces did not reveal blood upon examination. The urine showed two or three white cells in each $\frac{1}{6}$ objective microscope-field. Examination of the blood revealed 80 per cent. of hemoglobin and a leukocytosis of 11,800.

COMMENTS

Dr. Murphy (November 23, 1915): Word was received from the hospital where the patient was operated upon in March, 1915, that a mass about the size of a goose's egg was found in the midst of the small intestines, which were adherent to each other, as well as to the anterior abdominal wall: whether the mass was of inflammatory or neoplastic origin was not determined. Since it was not considered advisable to dissever the adhesions or attempt to remove the mass, lateral anastomosis was performed between the small intestine proximal to the mass and the upper portion of the sigmoid (ileosigmoidostomy): the abdomen was closed without drainage.

The history of chronic cough, weakness, night-sweats, loss of appetite and of weight suggests pulmonary tuberculosis; while the abdominal cramps, frequent bowel-movements with undigested food-particles, and rectal tenesmus, when taken in conjunction with the finding of a conglomerate mass of intestines at the time of the operation, which was performed elsewhere, suggest intestinal tuberculosis.

The patient is suffering from pain and discomfort. On palpation the mass seems still to be about the size of a goose's egg: the question is whether or not it can be removed. The tuberculin test was positive.

OPERATION

[Exploratory celiotomy revealed multiple foci of tuberculosis involving and agglutinating coils of small intestine, in which ulcers could be palpated and recognized without difficulty. The retroperitoneal lymph-nodes were involved and greatly enlarged. Resection of bowel and ablation of tuberculomata being out of question, after accounting for sponges and instruments, the wound was closed without drainage.]

POSTOPERATIVE COMMENTS

In tuberculosis of the intestines we have to deal with a lesion which, until modern times, was considered incurable. Previous to the use of tuberculin, no cure of a tuberculous ulcer of the intestines had ever been recorded. When Koch's tuberculin came into use Paul Goodman, of Berlin, presented four specimens of healed tuberculous ulceration of the intestine to the Virchow Pathologic Institute: Virchow said of them that they were the first examples of completely healed intestinal tuberculosis which he had ever seen.

Tuberculous peritonitis treated by tuberculin heals more rapidly than tuberculosis of any other tissue in the body, for it comes under the classification of pure tuberculous infections, and tuberculosis *per se* rarely terminates fatally.

Tuberculous enteritis, on the contrary, occurs in a field in which mixed infection is constantly present: the tissues are unable to cope alone with the combined destructive effects of the tuberculous and non-tuberculous infections, and, like lupus, heal in one place while breaking down in another. Without tuberculin these tuberculous nodules do not heal at all: they destroy life by diarrhea, exhaustion, and by producing stenosis of the gut from cicatricial repair of the transversely spreading ulcers.

There is another interesting feature about the tuberculous intestinal nodule: it destroys the mucous membrane by spreading in an upward instead of a downward direction: reinfection does not occur, as a rule, from arrest of tubercle bacilli on their way downward, but from the tubercle bacilli which are conveyed upward by the proximally coursing lymph-stream, to lodge in the solitary submucous lymph-nodes at intervals of from 1½ to 2 inches. We observed this proximally directed advance of the infection very early in our intestinal work. I recall a patient from Ohio who, for fifteen years, had complained of recurrent intestinal cramps and diarrhea, and ultimately of intestinal obstruction, which was practically complete. Physical examination revealed an induration in the abdomen, the nature of which was by no means obvious. Exploratory celiotomy revealed tuberculosis of the ileum, the oldest lesion being the one with the greatest amount of cicatricial tissue: from this oldest lesion the younger ones had spread in an upward direction for a distance of 5 feet, with gradually decreasing degrees of cicatricial density. The entire zone was resected and the patient made a complete recovery. This patient, too, has a good chance of recovering completely: she will be treated by therapeutic doses of *x*-rays and tuberculin.

Postscript (*January 1, 1916*).—The stitches were removed on December 7, 1915, two weeks after operation. Tuberculin and *x*-ray treatments were begun one week later, on December 14th. By December 21st the wound was entirely healed with the exception of a very small area, and there was practically no discharge. The patient left hospital shortly afterward.

(For further information on this subject consult Dr. Murphy's article on "Tuberculosis of the Alimentary Canal and Peritoneum," which appeared in the *Illinois Medical Journal* for March, 1912.)

FECAL FISTULA—CLOSURE BY ENTERORRHAPHY (TWO CASES)

Summary: Case I.—Clinical history of patient; comments—review of events leading up to fistula; reduction *en masse;* importance of resecting bowel wide of gangrenous area; operation—abstract of findings and manner of dealing with them.

Case II.—Clinical history of patient; comments—review of development of fistula; rarity of rupture of appendiceal abscess into urinary tract; the seed-test for intestinal fistula; plan of operation for fecal fistula; avoidance of injury to ureter; operation—exposure and closure of fistula.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-six years of age, was admitted to Mercy Hospital September 21, 1915. The family and past histories are negative.

In 1909, 1910, and 1911 the patient had three severe attacks of dull pain in epigastrium. The pain bore no relation to meals and lasted three or four hours: during and after the pain the patient was nauseated, but did not vomit. There was no fever, nor were there any chills.

On February 16, 1911, the appendix was removed: following the operation a stitch-abscess developed, but healed within one week. There was no further pain in the stomach.

On February 26th—ten days after operation—there appeared fever, chills, and pain in the right arm and chest, which localized in the region of the liver. Gaseous distention of stomach and nausea were present, continued for from five to six hours after each meal, and were relieved by vomiting. The bowels were open. Examination of the blood revealed leukocytosis.

On March 14th—sixteen days later—a subhepatic abscess was found at operation and evacuated, and tubal drainage was established: the wound discharged for four weeks and then healed. After this second operation the patient was restored to good health.

In January, 1912, after a sudden exertion, the patient felt sharp pain in the lower right quadrant of the abdomen, and noticed two bulgings—one on the right at the site of the appendicitis celiotomy-scar, and the second on the left, in the inguinal region. Although an abdominal support had been worn, yet the celiotomy-hernia gradually increased in size.

On August 3, 1915,—nearly four years after the appearance of the herniæ and seven weeks previous to admission,—the right-sided celiotomy-hernia and the left-sided inguinal hernia were operated upon at one sitting in his home town: no pus was found during the operations. For four days after the operation there was obstruction of the bowels: fever was present, but chills were absent.

On August 7th—four days after operation—the fourth and last operation previous to admission was performed. The abdomen was opened through the linea alba, below the navel: a segment of bowel was gangrenous and bathed in pus; three inches of small intestine were resected, and an end-to-end button-anastomosis was performed; drainage was inserted, and pus and feces were discharged. During the next two days fever and chills were present, and at the end of the second day the median incision gave way and a profuse discharge escaped: left inguinal lymphadenitis appeared. Later both hernial postoperative incisions gave way, discharged purulent material profusely for four weeks, and then healed.

At present there is a fecal fistula in the midline. There has been no bowel-movement through the rectum since August 8th—the day after the last operation.

COMMENTS

Dr. Murphy (September 28, 1915): The feces are all escaping through the midline fistula: there is no discharge of feces from the right or the left hernial postoperative incision.

The first two days following the hernial operations were uneventful; on the third day the patient complained of abdominal discomfort from distention; on the fourth day he was enormously distended and began to vomit; some angulation must have been produced from reduction of the right-sided postoperative hernia *en masse*. Those who are familiar with the literature of hernia know that there may be adhesions at the neck of the hernial sac, and that if these are not recognized and dissevered at the time of operation, strangulation of the bowel is liable to occur from this "reduction *en masse*." Such was the sequence in this case—one of these adhesions produced a mechanical obstruction, with dilatation and later gangrene of the bowel from distention.

The untoward course following the operation of resection of the bowel on August 7th—the suppuration and the development of fecal fistula—was due to the fact that the resection was performed too close to the gangrenous area of bowel, and a button was used in the presence of pus and feces in the peritoneal cavity. Many years ago I called attention to the importance of going wide of the gangrenous bowel when performing resection for intestinal obstruction, in order to insure the approximation of *healthy* bowel-ends: if this union is made too close to the gangrenous area, the patient will die from leakage-peritonitis within from seventy-two to ninety-six hours.

There is no operation in the entire realm of surgery which I dread so much as the one which we have before us this morning, because the intestines are adherent clear down into the pelvis, and the fecal matter from the fistula must be kept out of the field (Figs. 87–91).

Injection of methylene-blue through the rectum escaped through the fistula, showing that it is not far from the sigmoid flexure.

OPERATION

[After exposure of the abdominal contents it was found that from ulceration a large opening about three inches in length existed in the caput coli, and that the small intestines were involved in numerous adhesions, with a transverse communication between two coils on the left side, at the site of the button-anastomosis, the button resting upon one of the coils. With difficulty the intestine was freed from adhesions to the anterior

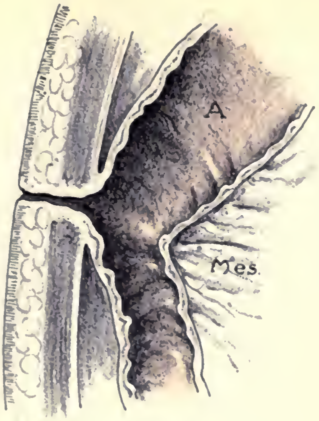

Fig. 87

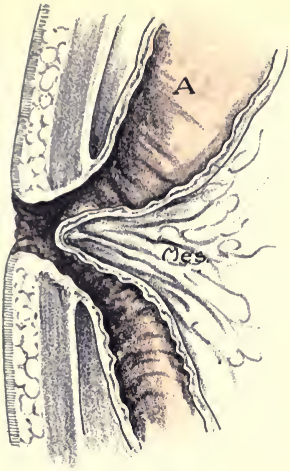

Fig. 88

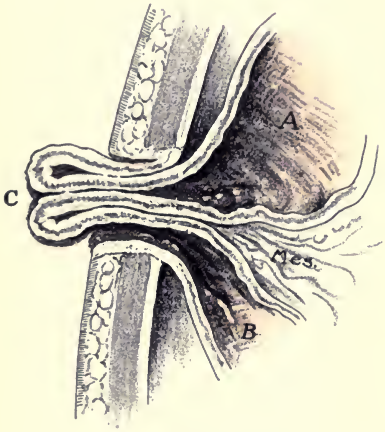

Fig. 89

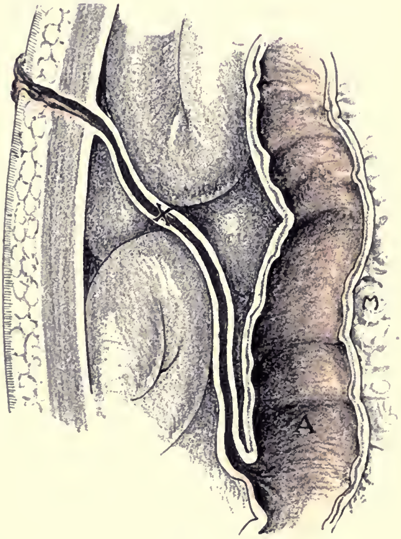

Fig. 90

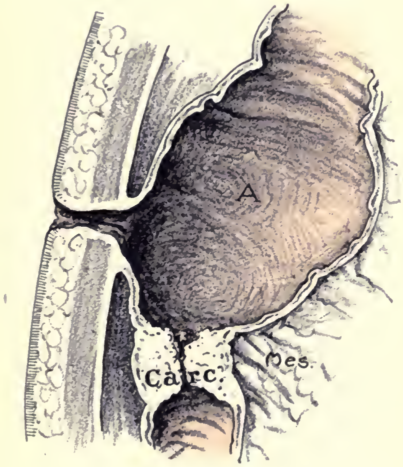

Fig. 91

Figs. 87–91.—Types of fecal fistulæ: Fig. 87: Simplest form. Fig. 88: Spur formation, or reducible-hernia type. Fig. 89: Artificial anus, or irreducible hernia. Fig. 90: Fistula leading to intestine remote from abdominal wall (the type in which Beck states that injections of bismuth paste "will be of great service"). Fig. 91: Fistula leading to intestine above cancer. (Modified from Coffey.)

abdominal wall, the button was removed, and, using a Czerny-Lembert suture of chromic catgut, an anastomosis was made at the site of the second fistula. The opening in the cecum was closed, and the ileum was brought over and stitched laterally to give support to the line of union, whereupon the approximation appeared to be very secure. Drainage was established by means of rubber tubes; sponges and instruments were accounted for, and the wound was closed under great tension by figure-of-8 through-and-through sutures. An intravenous infusion of a liter of normal saline solution was given on the table. A rectal tube was inserted to prevent accumulation of gas in the large bowel. The operation consumed three hours, but the patient left the table in fairly good condition. The head of the bed was elevated immediately after the operation, and ¼ grain of morphin was administered.]

Postscript (October 29, 1915).—The patient is still in hospital, and his condition is very satisfactory.

Ten days following the operation there was a pus discharge from the mid-wound, and five days later feces appeared. He had been having, however, frequent bowel movements *per rectum.* He was then given some *x*-ray treatments and the fecal fistula closed. Four weeks later another point of suppuration appeared, and again there was a fecal leakage, which finally closed completely.

February 25, 1916.—The patient left hospital January 13, 1916. The sinus has opened up and closed again a number of times since he left.

CASE II

CLINICAL HISTORY OF PATIENT

A MALE, thirty years of age, physician, was admitted to Mercy Hospital December 10, 1915. The family history is negative. When three years of age the patient suffered an attack of diphtheria, which was followed by paraplegia and strabismus.

Four years previously, in November, 1911, the patient was operated upon for appendicitis. Fever came on five days after the operation, but soon subsided. Ten days after operation the temperature rose to 102° F., and there was a severe chill. There was no pain in the side, nausea, or vomiting.

About the twelfth day after operation the patient noticed that, when standing on his feet, the right thigh was flexed at the hip and that he could not extend it fully: there was also a "lump" in the right side, about the size of an orange.

In January, 1912,—two months after the first operation,—the second operation was performed: the wound was reopened and a drainage-tube was inserted. During the night after the operation "something broke," and the next morning the dressings were found saturated with pus. The wound continued to discharge until September.

On September 1, 1912, the third operation was performed: a fistulous tract was followed to the right renal region, and a stab-wound for drainage was made in the right lumbar region, above the iliac crest. After the operation the sinuses in front healed promptly, but the sinus in the back continued to discharge yellow, purulent material.

One month after the operation the patient was attacked by a severe cramp in the abdomen, and the wound began to discharge dark-brown material with fecal odor: the pain lasted about one hour and was not severe enough to require morphin-relief. These attacks recurred at intervals of from four to six weeks until June, 1914: in the intervals between the attacks of pain yellow pus was discharged.

In June, 1914, the fourth operation was performed: the lumbar fistula was dilated, and a drainage-tube was inserted; at the same time large doses of autogenous vaccine were administered. The tube was gradually shortened, and the fistula closed in the fall of 1914. The patient did not wear a dressing for two months.

In October, 1914,—four months after the fourth operation,—after the patient had taken a short motor ride, the wound partly reopened and began to discharge, but healed after being incised and drained.

In January, 1915, after unusual muscular exertion, profuse hematuria appeared, and the next day the wound again partly reopened: after incision and drainage of the wound the hematuria rapidly subsided, and the discharge stopped and did not recur for four weeks.

In February, 1915, the hematuria reappeared, but stopped after incision of the abscess, which had formed at the site of the wound. Urinalysis at that time showed albumin, casts, renal and vesical epithelial cells, and blood-cells coming from both kidneys. This renal condition was promptly cleared up by the administration of urotropin with the patient in bed and upon selected diet. The severe cramps were relieved, and the patient gained in weight.

On February 22, 1915, the patient passed fig-seeds and a husk of popcorn through the sinus (fistula): at times he had noticed suspicious particles in the discharge, but this was the first evidence that the sinus communicated with the bowel, *i. e.*, that there was a fecal fistula.

Examination revealed no fixation of the spine, nor any evidence of psoas abscess.

COMMENTS

Dr. Murphy (December 13, 1915): Primary union followed the operation for appendicitis, but twelve days later fever appeared, and the patient noticed a lump in his right side, and the thigh was flexed, indicating that the psoas muscle was tense. The infection was well back of the caput coli, in the zone of the psoas muscle: there then followed a course of recurrent opening and discharge. The probabilities are that the abscess ruptured into the urinary tract.

These are rare lesions: in the early articles we wrote upon appendicitis rupture of an appendiceal abscess into the urinary tract was mentioned as one of the complications, but I have not seen such a rupture since fifteen or eighteen years.

At some place this sinus communicates with the lumen of the bowel, forming a fistula, because within the last few weeks the patient passed seeds through the tract. Seeds are the best and simplest means of determining such a communication: just feed the patient some strawberry jam for five or six days, when finally some of the seeds will begin to pass through the fistula, as nothing else will.

Owing to the recurrent attacks of inflammation of the peritoneum we must expect to encounter matting of the intestines to the abdominal wall and to each other.

The diagnosis of fecal fistula having been established, the plan of operation requires, first, entering the peritoneal cavity above or below the site of the fistula; secondly, freeing the bowel at the site of the fistula from the abdominal wall, excising the fistula, and finally closing the perforation by making an entropion of its edge into the lumen of the bowel (Fig. 92). If these steps are not successfully executed, recurrence follows recurrence, as in this patient. The average time for this operation is two and one-fourth hours, and sometimes three hours are consumed, as in the previous case.

A most serious accident which we fear in this case is that of encountering and removing a portion of the ureter before recognizing it, because the anatomic lines of demarcation will be practically all obliterated from infiltration, and one does not recognize the tissues until after he has opened them, or even until they are out on the table.

OPERATION

[After opening the peritoneal cavity the zone of fixation of bowel at site of fistula to anterior abdominal wall was exposed, first from below and on the inner side, and then from above and on the outer side, until the fingers contacted when passed around the zone of fixation; after controlling the fecal current by clamps the fistulous opening in the intestine was detached from that in the abdominal wall; the caput coli was elevated and mobilized by cutting the posterior parietal peritoneum to its outer side; the intestinal end of the fistula was a minute orifice in the cecum, at the site of the stump of the appendix: it was closed by three tiers of chromicized catgut sutures; after accounting for sponges and instruments the wound was closed under tension by figure-of-8 through-and-through sutures, allowing room for the passage of tubal drainage. There was also posterior tubal drainage through the posterior sinus tract.]

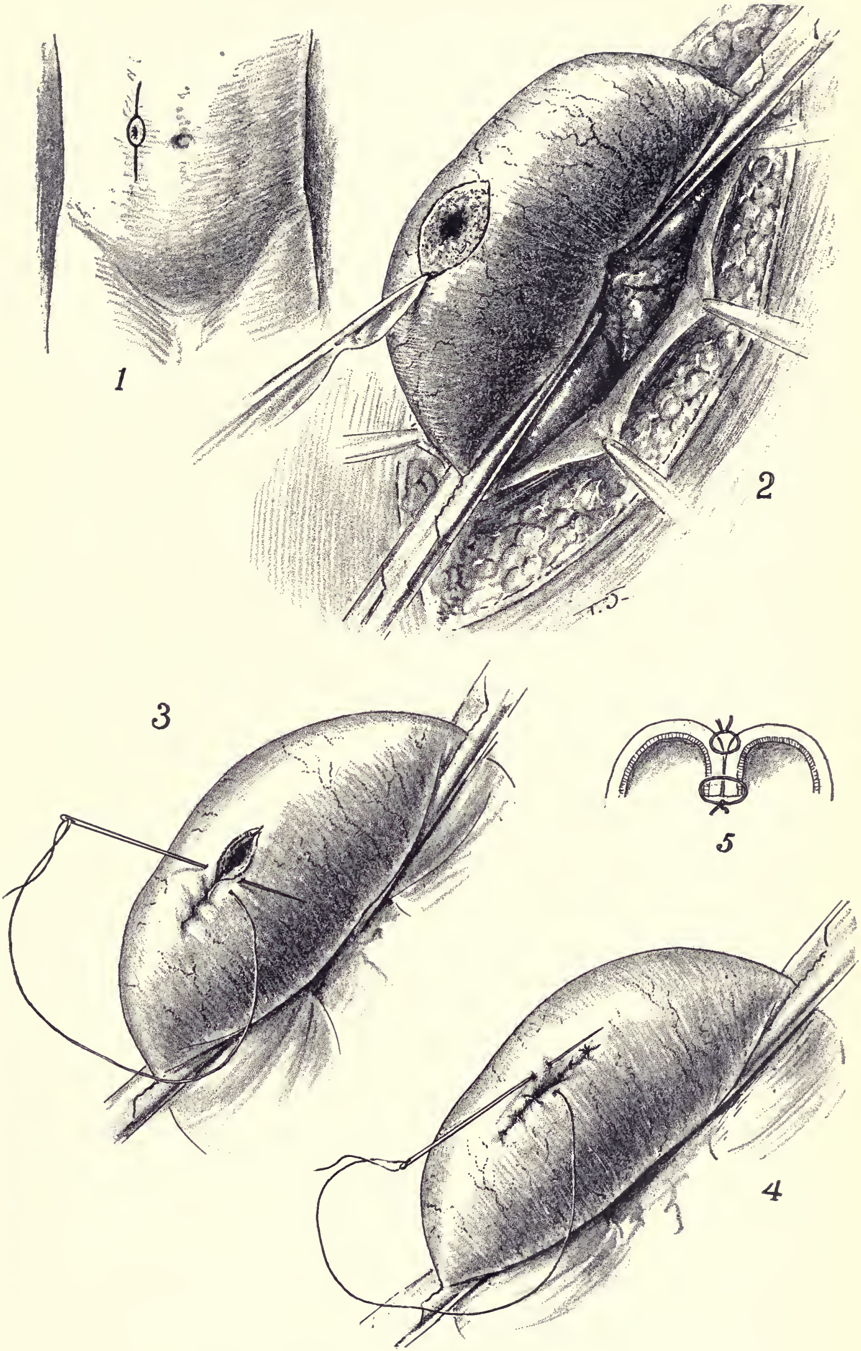

Fig. 92.—Steps in closure of fecal fistula (see text).

POSTOPERATIVE COMMENTS

Rushton Parker, of Liverpool (*Med. Press and Circ.*, March 22, 1916, 257), makes some interesting comments upon fecal fistula:

"One somewhat different case was that of a youth admitted into hospital having a dozen or more abdominal fistulæ. The case was one of typhoid, mild, no doubt, but said to have been treated at home, walking about, and fed on meat and potatoes! Some of the fistulæ were discharging feces, others pus, and all were judged to be perforations of small intestine. The patient was now fed chiefly on beef-tea, and the affected skin was covered with waterproof tissue, daily cleansed, and reapplied under a draw-sheet. The sinuses discharging pus soon discharged only serum, those discharging feces gradually discharged only pus, and eventually serum, followed in every case by drying up. The patient completely recovered, and never seemed to have been seriously ill at any stage of his malady.

"This is the principle on which I have always treated the few fecal fistulæ of the abdomen that occurred now and then after operation and reduction of strangulated hernia. One such case, in a woman, discharged through a stitch-hole after umbilical herniotomy. Nothing was done beyond reducing the diet as above described, and washing away the fecal discharge at the changes of dressing. In this and every case that I can remember the fistula dried up and got well."

Reporting good results in the treatment of fecal fistulæ with injections of bismuth paste, Beck (*Surg., Gyn. and Obstet.*, May, 1916, 510) states: "It is a fortunate circumstance that precisely in those cases where operations are very difficult or impossible the paste is of excellent service, while in those cases favorable for operation the paste is of comparatively little value. . . . It is customary with us, when a fecal fistula follows an operation, to wait at least two weeks for spontaneous closure. By this time, if the fistula has not entirely closed, it is usually narrowed down to small caliber and then the injections of paste (of thick consistency, so that it will not run into the bowel, but will fill out the usually wide channel and prevent the escape of fecal matter) are instituted at intervals of one or two days." (See Fig. 90, p. 468.)

Postscript (*January 4, 1916*).—Following the operation there was no discharge, and the tubes were removed. The wound healed *per primam*. The patient was discharged today.

March 25, 1916.—The patient reports that he has gained 20 pounds, and expects to resume practice this month.

(For a comprehensive discussion of the subject of fecal fistula see vol. iv, February, 1915, pp. 1 to 38; see also article by Coffey in *Annals of Surgery* for June, 1907, and Guthrie, on "The Prevention of Fecal Fistula in Suppurative Appendicitis," *ibid.*, April, 1916, 452.)

POLYPOSIS OF SIGMOID—ENTEROTOMY—ABLATION

Summary: Clinical history of patient; comments—analysis of history; characteristics of hemorrhage in tuberculosis; operation—enterotomy with ablation of polypi; postoperative comments—etiology of intestinal polypi; the germicidal action of lysol on colon bacilli.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-six years of age, was admitted to Mercy Hospital February 18, 1916. The family history reveals that one of the patient's grandmothers died from carcinoma of the uterus, and that one sister is suffering from carcinoma of the stomach. The past history is negative.

Ten years ago, after taking a large dose of a laxative, the patient noticed blood in stools.

From 1907 to 1912 the patient occasionally passed blood in stools: there was pain at times, and the bowels became more and more constipated.

In 1913 small amounts of blood were passed intermittently.

On February 3, 1916,—fifteen days before admission,—after driving to town in a buggy, the patient had a severe hemorrhage from the bowel, which was controlled by packing the rectum. There had been two copious bowel-movements on the morning of the day of the hemorrhage.

On the day of admission the patient's bowels were very loose, owing to his having taken castor oil the day before: there was also a painless discharge of bright red blood.

The patient feels fairly well, but has lost some weight. The course of the malady has been afebrile throughout. The patient has had no cough nor night-sweats. His appetite is good. There have been no gastric disturbances.

Proctoscopic examination with a 14-inch tube revealed dark blood throughout, but no ulceration. A clot of blood was obtained from the stomach by lavage on the day of admission. The tuberculin test was absolutely negative. Palpation revealed no tumor in any position in the abdomen, nor any evidence of increased peristalsis. The bismuth meal was negative.

COMMENTS

Dr. Murphy (February 19, 1916): At no time did the patient complain of food-discomfort. There are no symptoms or signs pointing toward disease in the upper abdomen. The history extends over a long period of time, and the malady is characterized by an afebrile course throughout. In tuberculosis—whether of lung or intestine—the rule is that a hemorrhage is preceded by fever and the patient feels sick. In tuberculous hemorrhage from the urinary tract no fever precedes the attack, since mixed infection is absent in that tract.

In our analysis we are unable to determine the source of the hemorrhage. Intestinal bleeding, which has continued for such a long period of time, is usually due to tuberculosis or polypus, of which the former gives rise to more profuse bleeding. I recall one patient with tuberculous enteritis who had bled intermittently for ten years: I saw him fifteen years after the onset of the symptoms, and at operation resected five feet of small intestine.

OPERATION

[Exploratory celiotomy revealed no evidence of disease in the upper abdomen, the small intestine, the ileocecal region, the ascending or the transverse colon; when the sigmoid loop was reached, however, palpation (Fig. 93) revealed several soft tumors which slipped around in the lumen of the bowel, between the palpating fingers. Enterotomy was performed through the anterior tenia coli, and on separating the cut edges of bowel, the polypi were exposed to view (Fig. 94). Each polypus was successively removed after transfixion and ligation of its base with catgut. Each incision into the bowel was accurately closed by Czerny-Lembert sutures, making an entropion of the cut edges, and each line of intestinal suturing was reinforced by stitching over it an epiploic tag. After accounting for sponges and instruments, the operative field was swabbed with lysol to destroy colon bacilli, and the celiotomy-wound was closed in the usual manner without drainage. A permanent rectal tube was fixed to relieve the sigmoid from gas tension.]

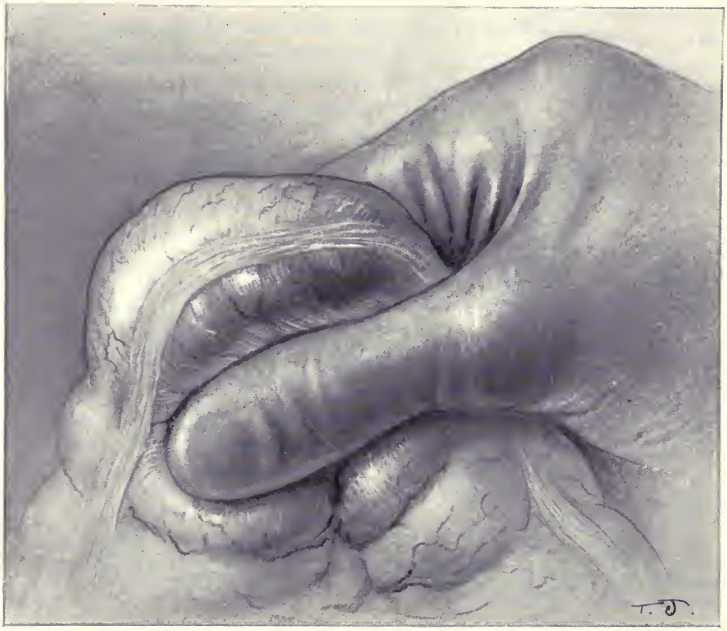

Fig. 93.—The palpating fingers detect slippery tumor-masses within the lumen of the sigmoid.

POSTOPERATIVE COMMENTS

The etiology of intestinal polypi—like that of the common wart—is shrouded in mystery: whence they come, why they go, is like the riddle of the Sphinx. The apparently causeless and symptomless "essential" hemorrhage from the bowel, and the absence of constitutional disturbances despite the chronicity of the lesion, both suggest the diagnosis, and are in complete accord with the pathologic findings at operation.

The colon bacilli, liberated by enterotomy, show a predilection for infecting fatty tissue—both the subperitoneal and the subcutaneous—rather than the peritoneum, the resisting powers of which are greater. We swabbed the operative field with lysol, in preference to the customary 5 per cent. phenol, because lysol exerts a stronger germicidal action upon the colon bacillus.

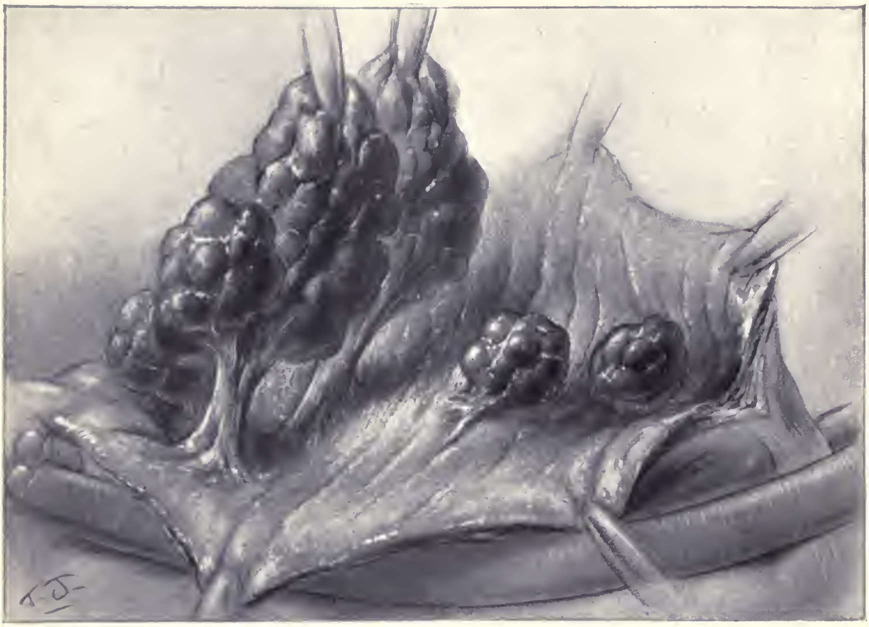

Fig. 94.—Polypi exposed after incising sigmoid through anterior tenia coli.

The patient's diet will be restricted to soup alone. We inserted a rectal tube in order to prevent the accumulation and retention of gas, which, if not allowed to escape freely, would subject the enterotomy wounds to a dangerous degree of tension.

Reporting a case from the Mayo Clinic and reviewing the literature, Carroll (*Surg., Gyn. and Obstet.*, April, 1915, 412–414) states: "Intestinal polyposis is a comparatively rare disease. . . . Polypoid growths may occur at any point along the gastro-intestinal tract, but in the majority of cases they are found in the large intestine, usually at its turning-points, and in the rectum. . . . Intestinal polypi may be single or multiple, the latter being more common. . . . Doering cites 24 cases of rectal polyposis in which carcinoma was present in 15. . . . The growths often cause obstruction and intussusception. . . . The symptoms usually vary with the position, size, and number of the polypi: hemorrhage, diarrhea, and vague abdominal symptoms, as colic and obstruction. . . . The diagnosis can be made only when the polypus is seen or felt. . . . Of 52 cases reviewed by Doering, only one patient was perfectly well after four years. In many cases the involvement may be so extensive as to preclude even surgical interference."

Postscript (*March 7, 1916*).—It is now seventeen days since the operation was performed: the stitches have been removed, and the patient is now permitted to sit up. There has been no more bleeding from the bowels.

Pathologic examination revealed polypi ranging in diameter from 1 to 2.5 cm. The microscope showed adenoma, with suspicious areas of active cellular proliferation.

PERIRECTAL SINUS—EXCISION

Summary: Clinical history of patient; examination; operation—excision of sinus; postoperative comments—discussion of congenital pararectal tumors and sinuses—the neurenteric canal.

CLINICAL HISTORY OF PATIENT

A FEMALE, twenty-eight years of age, was admitted to Mercy Hospital January 15, 1916. The family history is negative. Nine years ago, two weeks after an attack of puerperal sepsis, the patient had "neurasthenia"; there were severe pains in the spine, and a fever of 104° F. She did not recover for one year. Menstruation is regular but scanty, and is accompanied by severe pain in right side of pelvis and right thigh. There has been profuse vaginal discharge since the birth of her child, nine years ago.

In November, 1913, during a menstrual period, the patient suffered from severe, sharp pain low in the pelvis, and radiating along the rectum to the back; there were a chill and fever, and later a "perineal" abscess developed. After being incised, the abscess continued discharging for six months, and eventually the coccyx was resected; two more operations were performed, but the discharge has never abated for more than one week.

Of late there has been daily afternoon fever, but neither coughing nor night-sweating. The patient is often hoarse in the evening and continually during damp weather.

Examination by Dr. Murphy (January 20, 1916).—Bimanual pelvic examination reveals that the uterus is anteflexed, and although it cannot be moved from side to side, yet there is not enough infiltration in the fornices to account for the symptoms: neither tube is thickened, and Douglas's culdesac is clear. To the right of the rectum and behind it there is a limited area of infiltration. A sinus leads from behind the rectum down toward the lower margin of the tuberosity of the ischium, but no juxtaposition of the sinus with the stump of the coccyx is demonstrable. Cystoscopic and proctoscopic examinations were negative. The tuberculin test was also negative. Diagnosis: Retrorectal dermoid (Fig. 95).

OPERATION

[With the finger in the rectum as a guide, after an extensive dissection the sinus was followed behind the rectum to its termination: while it was close to the rectum, yet it did not communicate with the latter at any point, nor with the coccyx, and the rectum was not opened into during the operation. A large amount of cicatricial tissue from the previous operations was encountered. In order to obliterate the space left remaining after excision of the sinus the rectum was stitched snugly against the tissues behind it. A tube was inserted for drainage.]

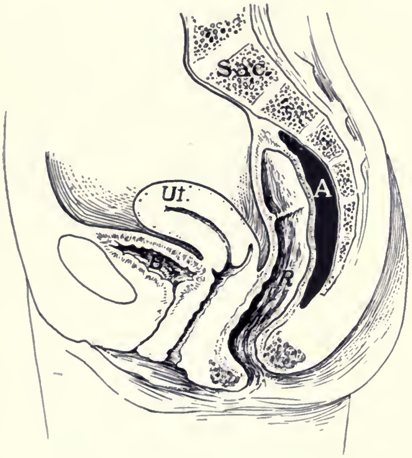

Fig. 95.—Retrorectal dermoid.

POSTOPERATIVE COMMENTS

In dissections in this region the nerves controlling the sphincter ani muscles are jeopardized, and the wound left remaining is extremely slow to heal. The stitches will not be removed for two weeks; and during that time, in order to counteract intra-abdominal pressure upon the rectum, the patient must lie flat on the abdomen in bed, notwithstanding the difficulty of emptying bladder and bowel while in that position.

Owing to the proximity of the sinus to the rectum there is always the danger of infection of contiguous tissues occurring; and an abscess behind the rectum should suggest, first of all, an infected retrorectal dermoid, because of the frequency of the latter tumor in this situation. An abscess resulting from an infected retrorectal dermoid may open into the rectum and discharge itself into it, leading to the mistaken diagnosis of ordinary abscess: if merely opened and drained, however, such a dermoid abscess will continue discharging until the epithelial lining of the cyst has been wholly ablated.

Retrorectal dermoids may reach the size of a walnut and even that of a child's head; they may extend anteriorly, pushing the rectum before them; and often upward into the abdomen, simulating an intrinsic abdominal tumor: if one should attempt to remove such a tumor through a celiotomy-incision under the mistaken diagnosis of pelvic cyst, he would get into a peck of trouble. I recall a case of this type in a girl who came from Cleveland: the uterus and adnexæ were shoved so far forward by the dermoid tumor that the uterus rested above the level of the pubes (Fig. 96). In removing these tumors the posterior route is the one of choice.

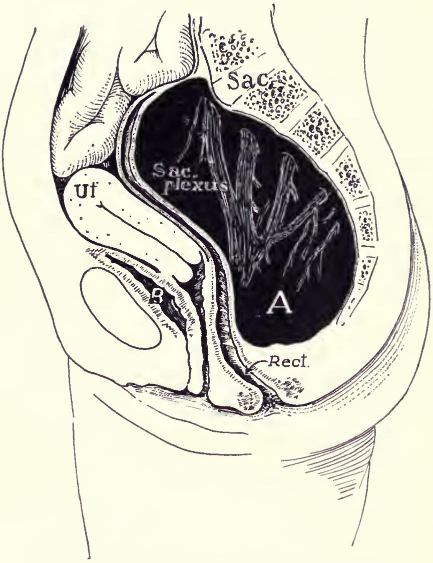

Fig. 96.—Colossal retrorectal dermoid.

There appears early in the human embryo a fissure at the head-end of the primitive streak. Soon converted into a canal, it opens into the vitelline sac. It is termed the *neurenteric canal* (Figs. 97 and 98) and is merely a temporary structure, its remains being represented in the adult by the sacral dimple. Occasionally remnants of this epithelium-lined canal persist and give rise to a pilonidal cyst, a subsacral mucous cyst, or a retrorectal dermoid.

Pilonidal cyst (Fig. 99) is illustrated in the case of a patient

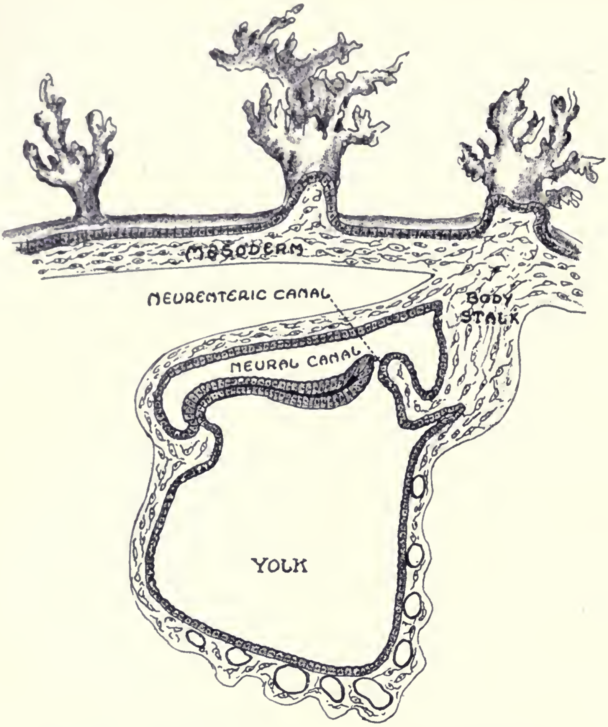

Fig. 97.—Orientation of neurenteric canal (Hertwig).

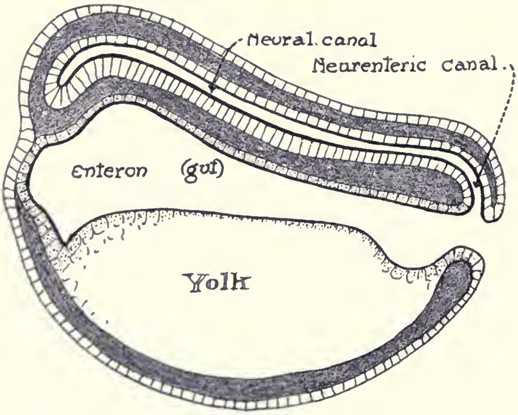

Fig. 98.—The neurenteric canal as a passageway between the neural tube and the hindgut (Hertwig).

who complained of "a discharging fistula at the end of the spine" of several months' duration. Examination revealed a dimple in the midline, near the upper end of the anal groove, which led into a sinus: this conveyed a probe upward and slightly forward for

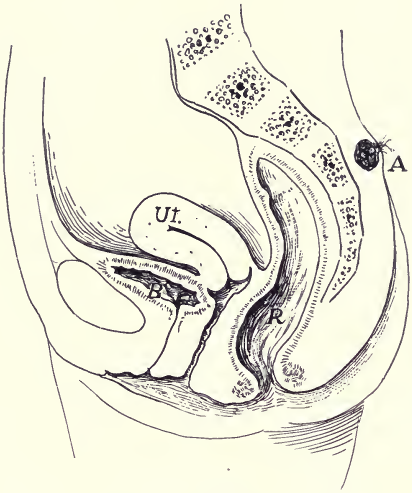

Fig. 99.—Pilonidal cyst.

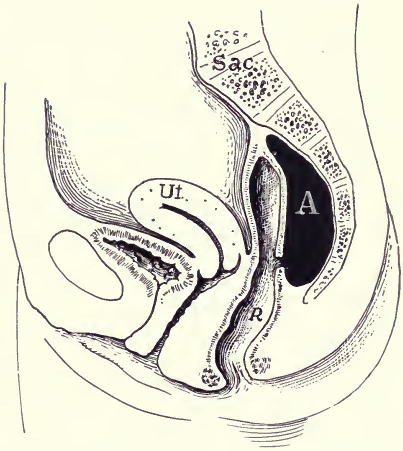

Fig. 100.—Subsacral mucosa-lined cyst.

three inches, and the removal of the probe brought away several dark, long hairs. The treatment is radical extirpation. In the differential diagnosis it must be distinguished from a sinus leading from a focus of tuberculous osteomyelitis, and possibly from a fistula-in-ano.

A subsacral mucous cyst represents the retention of a deeper portion of the neurenteric canal: it is found behind the rectum and is lined by columnar cells resembling those of the latter (Fig. 100).

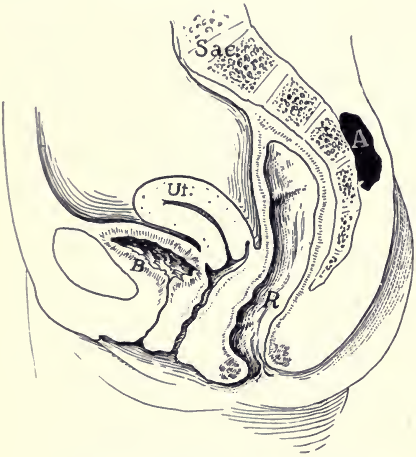

Fig. 101.—Retrosacral dermoid.

In reference to tumors in this region C. H. Mayo (*Surg., Gynec., and Obstet.*, January, 1916, pp. 11–17) writes: "Dermoid tumors, sacrococcygeal in type, are very common, and are caused by the rapid growth of the spinal column producing traction on the neural canal, which originally reached to the skin of this region. Here also are found the teratomata from the coccygeal body. These tumors contain mucous membrane from the post-anal bowel, nerve-tissue from the neural tube, bone and cartilage from the coccyx, and various inclusions of surrounding tissue. Some of them have mucous cysts lined with ciliated epithelium from the neural tube, showing the misplacement of tissue to have occurred before the third month of gestation."

(A case entitled "Postsacral Dermoid" (Fig. 101) was published in vol. ii, August, 1913, 647–649.)

Postscript (*February 25, 1916*).—The postoperative granulating sinus is practically entirely healed.

CARCINOMA OF RECTUM (TWO CASES)—CASE I—KRASKE ABLATION; CASE II—STAGE I: COLOSTOMY; STAGE II: KRASKE ABLATION

Summary: Case I.—Clinical history of patient; comments—one- *vs.* two-stage operations; first operation—iliac sigmoidostomy; second operation—Kraske ablation; third operation—application of Dupuytren's clamp; postoperative comments—importance of early recognition of cancer and early operation; mortality statistics of cancer of rectum; selection of cases for operation.

Case II.—Clinical history of patient; comments—charlatan bests ethical practitioner in recognition of cancer of rectum; procrastination in cases of cancer fatal; first operation—steps of Kraske ablation; second operation—for prolapse of rectum.

CLINICAL HISTORY OF PATIENT

A MALE, thirty-five years of age, was admitted to Mercy Hospital October 22, 1915. The family history revealed that the patient's father died at the age of thirty from tuberculosis of the "stomach," and that a maternal grandaunt died from carcinoma of the breast. Twelve years previously the patient suffered for one year from hemorrhoids. Seven years previously he had an attack of typhoid fever.

In December, 1913,—nearly two years ago,—the patient noticed for the first time increased frequency in the desire to defecate: he went to stool ten or twelve times a day, and experienced difficulty in the act, as though the feces were blocked in their downward passage; at times there was no passage at all, but merely rectal tenesmus. The stools were flattened.

This state of affairs gradually became worse, and the stools flatter and flatter and streaked with both mucus and blood, but mucus was never passed without feces. Since four months there has never been a bowel-movement unassisted by cathartics, which the patient must take daily. There is no true pain with the bowel-movements, but merely a sense of discomfort.

Since one year there has been weight- and dragging-discomfort throughout the lower abdomen: this is becoming worse. The patient has lost 25 pounds in weight. He feels weak. He has had no chills, fever, or headache.

COMMENTS

Dr. Murphy (October 23, 1915): Proctoscopic examination reveals a malignant neoplasm on the posterior wall of the rectum, beginning three inches above the anus: how far upward it extends could not be determined, owing to the stricture that is present.

The desirable method of treatment is radical removal of the neoplasm at one sitting, but this would expose the patient to too much hazard from feces streaming over the operative field, giving rise to suppuration and sepsis. I propose, therefore, to perform a two-stage operation, in the first stage establishing an artificial anus, and in the second ablating the neoplasm by the Kraske method, if there are no metastases within the abdomen contraindicating an operation. We shall try to preserve the integrity of the sphincter ani muscles by securing end-to-end union. In accomplishing the first stage the chances of infection are diminished.

A reëstablishment of the lumen of the intestines as a continuous tube for the feces may be accomplished by the application of Dupuytren's clamp, without performing laparotomy.

FIRST OPERATION

[Through a left McBurney-McArthur incision an unopened segment of sigmoid flexure was brought up and stitched to the margins of the celiotomy wound, according to technic described in vol. v, February, 1916, 42—illustration on p. 40.]

SECOND OPERATION

[On December 10, 1915, the rectal neoplasm was ablated by the usual Kraske method. Comparatively little blood was lost, but an intravenous infusion of saline solution was administered before the patient left the operating-room. The lower tube was removed on December 21st, when union was firm. Rectal injections of a 1 : 2000 solution of the hypochlorite of calcium were administered.]

THIRD OPERATION

[On January 12, 1916, complete primary union of the Kraske field of operation was found, and there was no evidence of return of the disease. The Dupuytren clamp was applied to the colostomy spur, according to the technic illustrated in vol. v, February, 1916, p. 41, Fig. 8.]

POSTOPERATIVE COMMENTS

It is greatly to be regretted that a patient should be allowed by his medical attendant to suffer from carcinoma of the rectum for two years before coming to the operating-table: to relieve these sufferers *early* radical operation should be performed, instead of failing to examine the patients and giving them suppositories. Like many cases of cancer of the uterus, all cases of carcinoma of the rectum are received by the surgeon in the superlatively advanced stage of the disease. The rectum is one of the very favorable fields for the removal of carcinoma, as is true of the remainder of the large intestine (see vol. v, February, 1916, 15).

The immediate mortality for radical ablation of cancer of the rectum has been diminished to about 20 per cent., and when performed by this two-stage method (Figs. 67, 68, 69, 70, 71, pp. 374–6), I think that it has been further diminished to 16 per cent., while the combined laparotomy and Kraske operation, according to Schloeffer, in 36 cases had a mortality of from 54 to 60 per cent. (Heller). In a collection of 343 cases by 33 authors the average mortality was 28.8 per cent., being 36 per cent. in males and 15 per cent. in females. Of 134 cases that survived the operation, 31 lived over the three-year period. This, if taken to represent the probable recurrences from the total number, is a little over 9 per cent.—not a very flattering showing, and decidedly against the combined one-sitting operation from an immediate mortality standpoint. In an article upon the direct operative treatment of cancer of the rectum Hartmann (*Journal de Chirurgie*, 1913, xi, 2, pp. 692–702) reviews the subject from the historic, statistical, and bibliographic aspects. Of 1665 cases operated upon by the perineal or sacral route, 264 died from the effects of the operation—an immediate mortality of 15.8 per cent.; while of these 1665 cases, 825 were followed up, and recurrences were found in 561, or 68 per cent., so that of these patients operated upon by the perineal or sacral route, 84 per cent. succumbed to operation or to recurrence. Hartmann advocates the combined abdominoperineal method of extirpation, and of 260 cases operated upon by this method, there was an immediate operative mortality of 98, or 37 per cent., and an ultimate mortality of 18 per cent. from recurrence, the combined mortality being 55 per cent. Hartmann presents the following conclusions:

"In spite of its considerable immediate gravity, the operation elaborated for cancer of the rectum by the abdominoperineal route seems to me to be an operation of the future because, from the standpoint of recurrences, it is incontestably superior to all methods previously practised. A larger percentage of immediate cures will be obtained by avoiding the mistakes which we have previously made, by practising systematically terminal colostomy, and by judiciously selecting the cases.

"In the future we shall reject the operation in patients over sixty years of age, in the obese, and in those who have bad kidneys; on the other hand, we shall not limit the abdominoperineal operation to cases of rectosigmoidal cancer alone, but shall extend it to neoplasms situated lower down; and since cancers of the rectum are accompanied by adenopathies situated high up, they can be definitely cured only by an operation by the combined route—a method which alone permits heed to be taken of the general rule in dealing with cancer, that *radical operation means ablation of the tumor, together with the lymphatic territory which is secondarily invaded by it.*"

It appears from these statements that the removal of the adenopathies made a great addition to the permanent cure. This does not coincide with our analysis of the postmortem findings in a large number of cancers of the large intestine, including the rectum; 36.6 per cent. of 90 cases had no demonstrable metastases in the lymph-nodes or in distant organs on the necropsy table. It does not, therefore, seem justifiable that the additional hazard of the combined operation should be taken, because of the percentage of lymph-node involvements possibly present at the time of operation.

Postscript.—The patient left hospital early in February. When last seen on February 18, 1916, his condition was excellent.

CASE II

CLINICAL HISTORY OF PATIENT

A MALE, fifty years of age, was admitted to Mercy Hospital May 19, 1914. The family history is negative. Thirteen years ago the patient had an attack of syncope, and fifteen minutes later vomited about one quart of dark-red blood: this was the only attack of hematemesis. There is no history of epigastric pain or indigestion.

Ten months previous to admission,—in July, 1913,—after a difficult bowel-movement, the patient noticed in the stool a clot of dark blood the size of two fists: there was no pain in the abdomen or rectum during this passage. After this, dark blood, varying in amount from a streak to a teaspoonful, has been present in every stool.

In September, 1913, the patient again passed a clot of blood similar in color and size to the first clot: after passing it he felt very weak. There has never been passage of mucus or blood independent of feces.

Since September every stool has contained mucus and bright-red blood, varying in amount from a teaspoonful to half a cup; and there has been constant, dull aching in the rectum, which is relieved only by lying down.

Since December, 1913, the patient has lost about 20 pounds in weight. His appetite remains good.

Examination reveals a malignant neoplasm on the anterior wall of the rectum, just above the anus.

COMMENTS

Dr. Murphy (May 21, 1914): This patient's history is somewhat interesting. He had been treated for a long time by his family physician for hemorrhoids; not noticing any improvement, he consulted a charlatan, who said: "Sir, you are suffering from cancer of the rectum, and you must consult a surgeon in reference to undergoing an operation." This episode may be uncomplimentary to the ethical members of the profession, but nevertheless it is true. Even though he was a quack, the charlatan had had enough experience and had made a *sufficiently careful examination* to recognize the gravity of the patient's lesion, and very sensibly refused to assume responsibility for the case.

Procrastination in cancer patients is both unfortunate and unnecessary: all that it accomplishes is the dissemination of cancer-cells throughout the body, until it is impossible, by delayed operation, to save the patient's life. Even when cancer is right out in the open, as in the case, for example, of cancer of the lip, the physician and the patient's friends look at the lesion month after month before insisting upon operation (*vide* vol. iv, August, 1915, 600).

OPERATION

[The rectum, together with the anus, was removed by Kraske's method. As a guide to the position of the urethra during the operation a No. 26 French catheter was passed. After removal of the coccyx and lowest segment of the sacrum the rectum was exposed and freed from its attachments, the hemorrhoidal vessels being ligated *en bloc* with the regional connective tissue. After opening the peritoneum the rectum was brought down until it remained without employing traction. The rectum was clamped with a double angiotribe and divided accurately. A puckering suture was passed through the rectum one inch above the site of amputation, and a rectal tube was inserted to conduct the feces to the surface during the stages of repair. Another tube was inserted into the cavity which was left remaining after removal of the anus. The operative field was swabbed with 5 per cent.

phenol, and the space was closed with figure-of-8 silkworm-gut sutures. The catheter was removed. The perineum was reconstructed by a double row of figure-of-8 sutures. The ligated mass of tissue around the rectum was employed to elevate the stump of the rectum and retain it in a position flush with the level of the surrounding skin, thus establishing a sacral anus and preventing postoperative traction during the union of the rectum and skin.]

[*N. B.*—On November 2, 1915, the patient was operated upon for prolapse of the rectum. There was no evidence of return of the disease, and the portion of the prolapsed rectum was resected.]

Postscript.—Convalescence was rapid.

(For comments by Dr. Coffey on this subject *vide supra*, p. 373.)

(A case of carcinoma of the rectum was published in vol. iii, August, 1914, 775–81; one involving the splenic flexure appeared in vol. i, August, 1912, 581–9, and a second, close by that site and with secondary carcinomatosis of the peritoneum, appeared in vol. iv, April, 1915, 277–87.)

At the meeting of the American Surgical Association now being held at Washington, D. C., Dr. William J. Mayo reports that his mortality after excision of the rectum for cancer has now been reduced to 8 per cent.

UTERINE FIBROIDS (THREE CASES)—SUPRAVAGINAL HYSTERECTOMY. CURETTAGE (CASE III)

Summary: Case I.—Clinical history of patient; comments—analysis of history; malignant degeneration of fibroids; operation—suprapubic supravaginal hysterectomy by the posterior method.

Case II.—Clinical history of patient; comments—variations from type in clinical course of fibroids; emetin as a deodorant of offensive vaginal discharge; operation—similar to that in Case I; postoperative comments.

Case III.—Clinical history of patient; comments—analysis of history; operation—dilatation and curettage; removal of submucous polypus; postoperative comments—senile vaginitis.

CLINICAL HISTORY OF PATIENT

THE patient, forty-nine years of age, was admitted to Mercy Hospital February 17, 1916. The family history is negative. Menstruation began at thirteen years of age, is of the twenty-four-day type, lasts for three days, and required four napkins a day up until five years ago: since then each mensis has lasted one week and has required one dozen napkins a day. The patient has two children: there have been five miscarriages, but no abortions.

In September, 1910, while working in the garden, the patient became so weak that she was compelled to go into the house and lie down: while entering the house she had a sudden flow of blood from the vagina, and bled profusely until the hemorrhage was checked by a physician, who arrived an hour and a half later and packed the vagina. The patient was then removed to a hospital. The next morning the uterus was curetted.

On May 17, 1911, owing to the presence of the thyrotoxicotic syndrome, strumectomy was performed.

The latest menstrual period began on February 3, 1916, and lasted six days, terminating on February 9th. Two days later, having returned from a long walk, the patient noticed leukorrhea:

this lasted for two days, until February 13th, when a chill developed, and the patient felt faint and went to bed. Metrorrhagia began gradually and was profuse the next two days: on the third day large clots were passed, and thereafter the flow decreased in amount.

Upon closer questioning the patient made a statement which showed that an opportunity for infection of the uterus had arisen about four weeks ago, and that she was very ill after the chill developed on the thirteenth.

On admission to hospital there is still some bleeding from the uterus: the temperature is 98.6° F., and the pulse is normal.

Bimanual pelvic examination reveals a mass of wood-like hardness which is continuous with the uterus and extends clear up to the level of the navel, projecting more upon the left than the right side. There is no infiltration in the vaginal fornix on the right side.

COMMENTS

Dr. Murphy (February 19, 1916): The sudden, profuse hemorrhage which occurred in September, 1910, suggests miscarriage rather than fibroid, for the latter does not cause hemorrhage between menstrual periods, which is severe enough to require packing. After removal of the retained secundines by curettage no additional hemorrhage from that cause occurred.

The offensive leukorrhea, followed two days later by a chill, signified the onset of pelvic infection. The dragging of the uterus to the left is very suggestive of adhesions following infection of the left side of the pelvis: if adhesions are present, the removal of the fibroid uterus will be a much more difficult problem.

The fact that the patient has menstruated regularly up to her present age of forty-nine years, when taken in conjunction with the increased amount of flow at each period, gives rise to 65 per cent. of chances that a fibroid is present (*vide* vol. iv, April, 1915, 299).

Since it is a connective-tissue tumor, a fibroid is liable to undergo sarcomatous degeneration, but never carcinomatous: when carcinoma is associated with a fibroid, it will be found to involve the uterine mucosa, and not the fibroid itself. As the result of an examination of the specimens of uterine fibroid in the London museums Bland-Sutton found carcinoma of the mucosa associated with these tumors in 4 per cent. (see vol. i, February, 1912, 87–88). I, myself, have seen but one such case.

OPERATION

[Exposure of the pelvic viscera through a celiotomy-incision revealed adhesions extending from the left adnexæ to the uterus, dragging it to the left side, and showed fresh pus, as indicated by the friable adhesions. The uterus was for the most part directly in front of the fibroid, which therefore was situated chiefly in its posterior wall, extending down into Douglas's *culdesac*. On dissevering the adhesions there was revealed a left-sided pyosalpinx, from which pus was flowing out. The right ovary and tube were free from adhesions, and the left ovary was not diseased.

Including both tubes, the uterus bearing the fibroid was removed by the usual supravaginal method (for full description of steps of this posterior operation, together with illustrations of steps of technic, consult vol. ii, April, 1913, 181–195). Both ovaries were allowed to remain. Owing to evidence of the tubal infection being recent, a drain was inserted on the left side, behind the broad ligament. After accounting for sponges and instruments the celiotomy wound was closed with the exception of a foramen through which the drainage made its way.]

(*N. B.*—For a full discussion of pelvic infections consult vol. i, December, 1912, 810–824.)

Postscript (*March 9, 1916*).—It is now nineteen days since the operation was performed: the patient has experienced no further discomfort. There was no discharge of pus through the drainage-tube, which was removed on the tenth day. Convalescence was uneventful.

CASE II

CLINICAL HISTORY OF PATIENT

The patient, fifty-one years of age, was admitted to Mercy Hospital February 17, 1916. The family history reveals that the patient's mother died from cancer of the stomach. The past history reveals that the patient has enjoyed good health up to the time of the present malady. Menstruation began at fifteen years of age, is regular, of the twenty-eight-day type, lasts from three to five days, and requires one or two napkins a day.

Since two years menorrhagia has occurred at intervals of from two to three months, with the exception of from August, 1915, to February 9, 1916, during which time it did not make its appearance: it returned on the latter date, however, and has been present since.

The patient has been married twenty-six years and has borne two children: there is no history of puerperal infection.

One year ago there appeared dull pain in the right iliac region. Since then the pain has been present most of the time, but is never severe and does not radiate: there is tenderness to pressure in that region.

Fever, nausea, and vomiting have been absent. The bowels have been regular, and bladder symptoms have been absent. The abdomen has not become enlarged. There is marked offensive leukorrhea. The patient has lost no weight. The urine is negative.

Bimanual pelvic examination reveals a tumor on the left side of the uterus, which measures 2½ inches in diameter. Inspection shows mucus coming from the cervix, but no blood.

COMMENTS

Dr. Murphy (February 19, 1916): Here is a patient who continued menstruating up to the age of fifty, meaning that there are 65 per cent. of chances that she has a fibroid: if she has, there is an anomaly in her history in that she stopped flowing for six months and then suddenly flowed more than before—quite rare with a fibroid—just as rare as the bleeding in the interim in the last case. The rule with fibroid is that patients flow more and more, but once they stop, the flow does not return. This anomaly makes the case suspicious, especially when taken in conjunction with the fact that the patient's mother died from cancer.

Palpation reveals a large mass in the pelvis: if it is cancer, I should say that it involves the fundus, rather than the cervix, of the uterus. The odor of the leukorrhea did not mean anything to me, for even were cancer present, the odor would indicate merely a saprophytic infection of the neoplasm, and would continue until checked by operation or death of the patient. Recently we have succeeded in deodorizing many such cases by hypodermic injections of one-half-grain doses of emetin: we know that as a class amebæ are destroyed by emetin, and here the saprophytes which produce the odor are destroyed by the same drug.

Compared with carcinoma of the cervix, cancer of the fundus occurs about once in 100 cases.

OPERATION

[The uterus was removed according to the technic referred to in the preceding case. Examination of the specimen revealed an intramural fibroid in the posterior wall, and not far from the mucosa: there were also submucous fibroids. One small zone in the mucosa was depressed and suggested beginning carcinoma.]

POSTOPERATIVE COMMENTS

[The influence of fibroid and of cancer of the uterus upon menstruation has been discussed in vol. iv, April, 1915, 299; submucous polypi are discussed below; the morbidity of uterine cancer and the mortality statistics of operation were presented in vol. iv, October, 1915, 916.]*

Postscript (*March 9, 1916*).—It is now nineteen days since the operation was performed: the patient has been permitted to sit up, and in a few days will be able to leave hospital.

Pathologic Diagnosis.—"Fibrosis of the uterus and adenoma of the mucosa, with strong suspicion of beginning carcinoma."

CASE III

CLINICAL HISTORY OF PATIENT

THE patient, forty-eight years of age, was admitted to Mercy Hospital September 16, 1915. The family and past histories are negative. Menstruation began at twelve years of age, is regular, of the twenty-eight-day type, lasts three or four days, and requires seven or eight napkins a day. The patient has borne eight children. The next menstrual period after childbirth usually followed within five or six months. Menstruation has been irregular for the past ten years.

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* J. B. Deaver (unpublished paper) reviews the cases of fibroid uteri upon which he has operated at the German Hospital, Philadelphia, from 1905–1915 inclusive. Among the 750 cases there were 13 deaths (1.73 per cent.), while the last 100 of these passed off without a single fatality.

In 513 cases with complete pathologic reports carcinoma was found eight times.

After the birth of the last child,—ten years ago,—the patient did not menstruate for one year, and since then the intervals between the periods have lasted from one to twelve and even fourteen months: with each period the flow was profuse, and occasionally the patient had cramps, accompanied by backache.

In April, 1914, the flow lasted one week, was profuse, and accompanied by pains in the region of the gall-bladder and lower abdomen. There was no further flow until five weeks ago, when the patient had an attack of vertigo and pains in the lower abdomen, which were followed by metrorrhagia beginning during sleep: this flow has continued up to the present time, is increased by the slightest exertion, and at times forms large clots; during this time there have been occasional pains in the legs upon the slightest exertion.

COMMENTS

Dr. Murphy (September 18, 1915): Preceding the flow the patient had severe pains in the lower abdomen, which were expulsive in character, and the flow has persisted ever since: such a history does not suggest carcinoma, even though the family physician stated that he found carcinoma upon microscopic examination of a specimen obtained from the uterus; it suggests an intra-uterine fibroid or polypus, with expulsion pains.

OPERATION

[After dilating the cervix and examining it, no depression or excavation resembling carcinoma was found, and the curette could detach no tissue from the cervix. From the fundus there was curetted away a strangulated and gangrenous submucous polypus.]

POSTOPERATIVE COMMENTS

In this case the history coincided with the pathologic findings to a nicety, as the pain was due to the expulsion efforts of the uterus, which finally strangulated the intra-uterine polypus. A portion of this was evidently removed by the family physician and sent to a microscopist, who reported carcinoma, and complete hysterectomy was advised. The reason we took exception to this was because the clinical history of the case did not correspond with that of carcinoma.

Senile Vaginitis.—Occasionally an old lady comes to you with the story of not having menstruated for ten, fifteen, or twenty years, when suddenly a flow appears, which, while not in excess of a normal menstrual period, yet is of longer duration: as a rule, the patient says, "Doctor, I had a pain, which was a little like a labor pain." As soon as you hear such a history you know that the trouble is not cancer, but that it is probably a polypus. When the old lady comes to you with her hands trembling from paralysis agitans and tells you that she is having her "second childhood," and that there is a show of blood, do not make a diagnosis of carcinoma, notwithstanding the fact that you have heard me say that a flow at this age above the normal amount not preceded by pain is carcinoma in 100 per cent. Such a flow, however, is never equal to that of a normal menstrual period, and this show or "second childhood," as she calls it, is due to senile vaginitis instead of cancer: on the other hand, a flow occurring one, two, or five years after the climacteric, which is equal to or in excess of that of a menstrual period, is due to cancer on that evidence alone in 100 per cent.

Postscript.—The patient made an uneventful recovery, and continued well, without discharge of any kind, until March 30th (last report).

(Cases of uterine fibroid have been previously published as follows: vol. i, February, 1912, 80–90; vol. iii, August, 1914, 653–661, and 761–767; vol. iv, April, 1915, 297–303.)

EXTRA-UTERINE PREGNANCY (FOUR CASES) —SALPINGECTOMY

Summary: Case I.—Clinical history of patient; comments—analysis of menstrua history; examination; diagnosis from history; operation—left salpingectomy.

Case II.—Clinical history of patient; comments—rapid two-hour rise of leukocytes; physical examination at variance with history; operation—left salpingectomy; postoperative comments—negative physical examination accounted for by operative findings, with which, however, clinical history is in complete accord.

Case III.—Clinical history of patient; comments—dialogue with intern *in re* analysis of history; significance of a decidua; varieties of ectopic gestation (analytic table); operation—right salpingectomy; postoperative comment—appendicitis as an etiologic factor.

Case IV.—Clinical history of patient; comments—uterine *vs.* extra-uterine pregnancy; history typical for latter; operation—left salpingectomy; postoperative comments—operative method of checking acute hemorrhage by *coup-de-maitre.*

CLINICAL HISTORY OF PATIENT

The patient, thirty-three years of age, was admitted to Mercy Hospital November 3, 1915. The family history is negative. Eight years ago the patient was operated upon for appendicitis and lacerated perineum. She has been married fourteen years and has *one child eleven years of age:* there have been no miscarriages. Menstruation began at thirteen years of age, is regular, of the twenty-eight-day type, and lasts three or four days. The flow is not profuse, and there is no dysmenorrhea.

On August 1, 1915, a menstrual period began and proved to be normal in amount and of the usual duration.

In September—five weeks after the preceding menstrual period—the patient menstruated again: while this was apparently a normal menstrual period, yet it was delayed.

In October the patient did not menstruate in the regular way, but a slight show appeared on the fourth and continued until November 1st.

On November 1st the patient menstruated profusely and had a severe pain.

COMMENTS

Dr. Murphy (November 4, 1915): I shall review the essential features of this patient's history. She was admitted last night. She is thirty-three years of age: her last and only child was born eleven years ago; she has had no miscarriages nor any pelvic infection, unless the attack of appendicitis for which she was operated upon eight years previously may be considered as such. Her last normal menstrual period began August 1st. She menstruated in September, but this period was five weeks after her previous menstrual period had begun, and was prolonged, though otherwise normal.

Since the menstrual period in September the patient has felt a discomfort in her left side, which she did not have before: occasionally this discomfort amounted to a crampy pain.

On November 1st—four days ago—she began to have sudden severe pain in the pelvis.

In considering the probability of ectopic gestation the menstrual history is the all-important factor.

Examination—which must always be conducted very gently under these circumstances—reveals slight enlargement of the uterus, but not enough enlargement to correspond with an eight weeks' uterine pregnancy. There is a bloody discharge from the cervix. On the left side of the uterus there is a soft, pulpy mass which presses down into the vagina. Examination of the blood reveals a leukocytosis of 8400, which is against the presence of an acute inflammatory condition.

In the remoteness of the last labor, the change in menstruation, the cramp-like pains, and the mild explosion as the tube stretched, the history of ectopic gestation is unfolded. There was not a severe explosion.

When I saw the patient this morning I told her to rest up until we got through with our clinic, and that we would then bring her down for examination.

When the patient was operated upon eight years ago for removal of the appendix the round ligaments were shortened: no pelvic infection was found at that time.

OPERATION

[While making the celiotomy incision it was noted that the peritoneum was discolored, showing that there was free blood in the abdominal cavity. When the peritoneum was divided, there was a large outpouring of blood, much of it clotted. The round ligaments were found plicated and holding the uterus forward. The left tube was found enlarged, ruptured, and bleeding, and was removed: the fetus had escaped. The stump was inverted, lest adhesions should form. After accounting for sponges and instruments the celiotomy wound was closed without drainage.]

POSTOPERATIVE COMMENT

In this case it was not the physical findings, but the menstrual history that made the diagnosis.

Postscript.—The patient made an uneventful recovery and was discharged from hospital at the usual time.

CASE II

CLINICAL HISTORY OF PATIENT

THE patient, thirty-six years of age, was admitted to Mercy Hospital February 14, 1916. The family and past histories are negative. Menstruation began at thirteen years of age, is regular, occurs every four or five weeks, lasts two or three days, and requires one or two napkins a day. She has been married fifteen years. Seven weeks after being severely injured in a railroad accident she gave birth to a stillborn child: this was a forceps delivery, and although the perineum was badly lacerated, yet there is no history of infection following the parturition. The laceration was repaired later.

The last normal menstrual period began December 25, 1915: the flow lasted but one day, and the quantity was less than usual, requiring only one napkin.

On January 10, 1916, the next mensis appeared fifteen days ahead of time: there was just a slight flow,—a sort of brownish discharge,—and this flow continued until February 7th, between which time and the tenth there was no discharge at all. On January 20th there was quite a profuse discharge, but only one napkin was used.

On January 15th—five days after the appearance of the prematurely early menstrual period—the patient was suddenly attacked by sharp pain in the hypogastrium, which radiated down the posterior portion of the left lower limb: there were also a chill, which lasted half an hour, and fever of 100° F. She was tender to pressure over this area. She had a frequent desire to urinate, but could not. She did not receive a hypodermic for the pain.

On February 7th—one week previous to admission—a similar attack occurred.

This morning (February 14th), at 11 A. M., a third attack occurred: it was so severe that it doubled the patient up. There was no fever. She was brought to hospital about 3.30 P. M. and prepared for immediate operation. The leukocyte count at that hour was 15,800.

Examination on February 10th—four days previous to operation—showed that the uterus was freely movable and displaced somewhat to the left side, but not retroverted to a degree that would interfere with her becoming pregnant. Nothing was palpated in the vaginal fornices or in Douglas's *culdesac*. There was no discharge of blood from the cervix: the latter was patent and free from laceration and erosion. The uterine sound was passed through the cervix as far as the internal os, to ascertain the patency of the latter, but did not enter the cavity of the body of the uterus. While the history is that of ectopic gestation, yet there is nothing suggestive of that condition upon physical examination of the pelvis. There are, however, sensitiveness and resistance of the left pelvic brim on palpation.

Examination on February 14th revealed a mass in relation with the left adnexæ high up on the pelvic brim. The Abderhalden was mildly positive in two tests.

COMMENTS

DR. MURPHY (February 14, 1916—5.30 P. M.): The leukocyte count at present is 21,400—a rapid increase of nearly 6000 within the last two hours. The patient's history does not suggest an attack of appendicitis: there was neither nausea nor vomiting. In the menstrual irregularities the history is typical for ectopic gestation, but the physical findings were negative.

OPERATION

[Exposure of pelvic viscera through a celiotomy incision.] . . . The trouble is wholly on the left side: the abdomen contains a large quantity of fresh blood, but few clots. The left tube is situated above the brim of the pelvis, is ruptured, and the fetus has escaped (Fig. 102). The tube is still bleeding. It was removed, and the stump embedded in the usual way. The clots were removed from Douglas's pouch. The tube on the right side

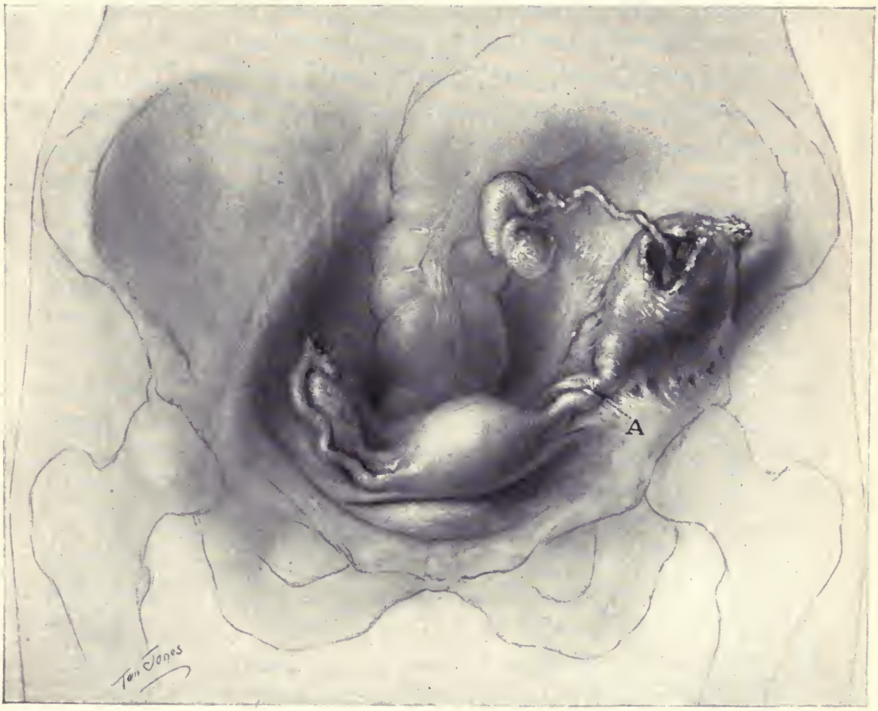

Fig. 102.—At "A" lumen of tube was completely obliterated, showing how impregnation had to take place through fimbriated end *via* opposite tube.

is patulous. [Left tube removed; sponges and instruments accounted for; incision closed in usual manner without drainage.]

POSTOPERATIVE COMMENTS

It is now apparent why I could not feel the distended left tube in the pelvis at the time of the physical examination, four days ago: it was drawn up out of the pelvis and fixed by adhesions to the outer side of the pelvic brim, thus being beyond range of the palpating finger in the vagina. The site of fixation of the tube was exactly where the patient located the pain. The clinical history was in complete accord with the operative findings.

Examination of the left tube showed that it was occluded about an inch and a half from the cornu of the uterus by the binding of it to the pelvic wall. This impregnation took place on the fimbriated side of this occlusion, which leads one to ask, How did the spermatozoön arrive in this position? It could not have come through direct from the uterus. It must have come through the right tube, was taken up by the left, and fertilization of the ovum, which had already been arrested at the point of constriction, took place in the left tube. That is a beautiful illustration of this method of fertilization. This case accentuates the significance of the clinical course of the disease, even to the operative stage, without being able to confirm the diagnosis by physical findings, and is most instructive from that standpoint.

Owing to the patency of the tube on the right side there is nothing now to interfere with subsequent impregnation of the uterus.

The head of the patient's bed will be elevated for eight inches.

Postscript (*March 1, 1916*).—It is now sixteen days since the operation was performed. The stitches were removed five days ago, and healing had taken place *per primam*. The patient's convalescence has been uneventful.

CASE III

CLINICAL HISTORY OF PATIENT

THE patient, twenty-nine years of age, was admitted to Mercy Hospital February 18, 1916. The family history is negative.

Menstruation began at sixteen years of age, is regular, of the twenty-eight-day type, painless, and requires one or two napkins a day. There have been no miscarriages.

In 1910 the patient had an attack of typhoid fever.

In 1911, after amenorrhea of seven months' duration, the patient had an attack of "peritonitis"; the uterus was curetted and found unimpregnated. Seven months after the attack of "peritonitis" the left tube and ovary were removed, together with a "mass" the size of an orange: no microscopic examination of the mass was made.

On October 12, 1915, a menstrual period began and pursued a normal course. The next two monthly periods—those of November and December—were missed: during these two months, while there was no morning sickness, yet the breasts were engorged and painful, and the abdomen was slightly distended; there was pain in the right lower quadrant of the abdomen, and the patient was dizzy and fatigued.

On December 25th, while being driven to the railroad station, the patient was suddenly attacked by a severe, sharp pain in the right lower quadrant of the abdomen: she was not nauseated and did not vomit. A hypodermic injection of ¼ grain of morphin was given, and the patient was put to bed. The temperature and pulse-rate were not taken.

On December 27th there was a very slight discharge of blood from the vagina—so slight that it required but one napkin a day. This very slight bloody discharge occurred daily until January 16, 1916, when the patient had what she regarded as a normal menstrual period. During these three weeks fever, chills, and accelerated pulse were absent.

On January 20th the patient had an *agonizing pain* in the right lower quadrant of the abdomen: thereafter she vomited every fifteen minutes, night and day, for three weeks. The temperature was normal; the pulse, 90.

Since January 16th there has been a scanty flow daily, requiring from one to three napkins a day.

On February 14th,—four days previous to admission,—on account of the continuing hemorrhage, the uterus was curetted, but no microscopic examination of the tissue removed was made.

Examination showed that the cervix was slightly enlarged and the uterus soft. A needle inserted through the vaginal fornix withdrew no pus. The Abderhalden test was positive.

COMMENTS

Dr. Murphy (February 21, 1916): What is the matter with the patient, doctor?

Intern: The history is very suggestive of ectopic gestation.

What was there in the history that makes you think of ectopic gestation?

The patient missed two successive periods in November and December: her last normal menstrual period began October 12th. On December 25th she had agonizing pain in the right lower quadrant of the abdomen, and a little later noticed a scanty flow of blood.

Was a membrane discharged?

There was none.

Why did I ask that? What do I mean by a "membrane"?

A decidua.

Yes, a decidua, the presence or absence of which bears upon the diagnosis between uterine and extra-uterine pregnancy, respectively, although at times there is a pseudo-decidua in the latter. The uterus was curetted long after the initial symptoms, but no decidua was examined for. On summing up, it is now four months and nine days since the patient had her last normal menstrual period; and for two and one-half months there was no disturbance other than that due to engorgement of the breast. Did she have any pain from October 12th to December 25th?

No, sir.

That is very exceptional for a case of ectopic gestation, in which the rule is that between the fifth and the seventh week after the last normal menstrual period sharp, shooting pains appear, become more and more severe, and eventually simulate true labor pains: the shooting pains result from rapid distention of the tube.

According to location there are three varieties of ectopic gestation—the interstitial, the ampullary, and the ovarian. In the interstitial variety impregnation of the ovum takes place in the isthmus of the tube, whence the impregnated ovum may become displaced outward through the ampulla, infundibulum, and ostium abdominale into the peritoneal cavity (*abdominal type*); or by rupture to a position between the two peritoneal layers of the broad ligament (*intraligamentous type*, Figs. 103 and 104); or inward through the pars uterina into the uterus, thence pursuing the normal course of uterine gestation (*intra-uterine type*). In the ampullary variety the commoner type is the abdominal, from rupture of the tube and discharge of the embryonic capsule into the free peritoneal cavity, as occurred in this case (*abdominal type*); less frequently this variety develops into the *tubo-ovarian type*. The latter, together with the *ovarian variety*, is the rarest of all.

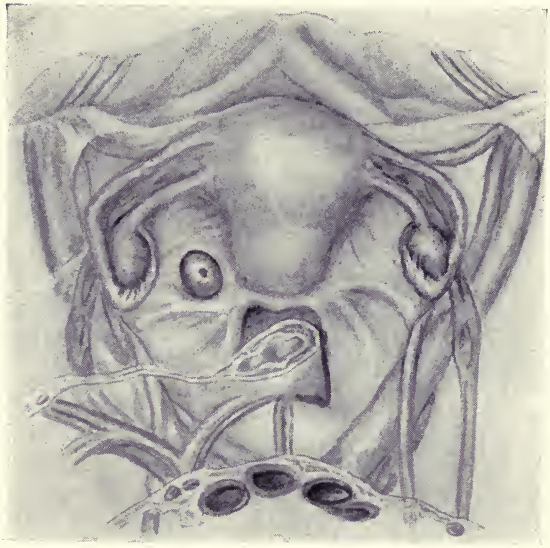

Fig. 103.—The ovum imbedded under the peritoneum of the broad ligament (Hirst and Knipe).

The etiology of tubal retention of the ovum is given in the classification which we have had placed upon the board. (See table.) [Here reviews history of preceding case.] . . . After leaving the ovary, the ovum may wander around in the abdominal cavity and eventually enter a tube, where, owing to one of the causes mentioned, it may become imprisoned (as in previous case) after impregnation, thus giving rise to tubal pregnancy.

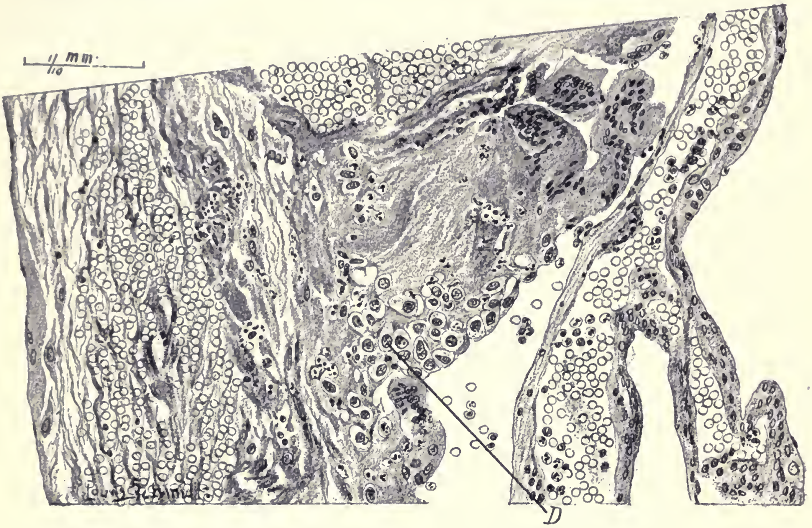

Fig. 104.—Decidual cell development in connective tissue of the broad ligament: *D*, Decidual cells (Hirst and Knipe).

ECTOPIC GESTATION

(Extra-uterine Pregnancy)

Causes of extra-uterine arrest:

A. Intratubal obstructions.
   1. Polypus.
   2. Diverticula (most frequent).
   3. Strictures.
   4. Atresia and migration.

B. Extratubal.
   1. Deformities.
   2. Adhesions, peritoneal.
   3. Salpingitis.
   4. Appendicitis.*
   5. Uterine myomata.

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* Neild, of Shanghai, reports a case of unruptured right-sided tubal pregnancy associated with chronic appendicitis (*Lancet*, March 25, 1916, 676).

Varieties:

1. Ampullary:
    - (*a*) Tubo-ovarian.
    - (*b*) Abdominal.
2. Interstitial:
    - (*a*) Abdominal.
    - (*b*) Intraligamentous.
    - (*c*) Intra-uterine.
3. Ovarian.

Symptoms: Often long period follows latest pregnancy.

1. Intermittent pains in pelvis of stabbing character; occasionally morning sickness, mammary pains, etc.
    Symptoms (*a*) Before rupture.
    (*b*) After rupture.
2. Passes next menstrual period.
3. Lancinating pain in pelvis with a menstrual show and then expulsion or "labor" pains with occasional passage of membranes—decidual casts (recurrent "atypical menstruation").
4. Five to seven weeks from last normal menstruation sudden severe expulsion-pains in the pelvis, with nausea, vomiting, pallor, and often collapse (due to rupture of tube and hemorrhage).
5. Physical signs:
    - (*a*) Tender tumor in fornix or pouch.
    - (*b*) Flatness on percussion.
    - (*c*) Distention of abdomen.
    - (*d*) Vaginal show.
    - (*e*) False abortion—false labor.
    - (*f*) Softening of cervix; enlargement of uterus and of breasts.

The first is the commonest primary manifestation of trouble.

Time of rupture:

Usually five to seven weeks; practically always before twelfth week; occasionally goes to full term.

Abdominal gestation Delivery False labor
Lithopedion

Prognosis:

Not operated, 68.8 per cent. mortality (Schauta).
Operated and non-operated, 28 per cent. (Veit).
Operated (Johns Hopkins), 5 per cent.

Time for operation:

As soon as the diagnosis is made, and preferably in the preperforative stage, as urged by Dorland (*Jour. Kansas Med. Soc.*, November, 1915).

In 1911 this patient was operated upon for left-sided ectopic gestation: the tube and ovary were removed, together with a hematoma; we should, therefore, expect to encounter adhesions.

Diagnosis: Tubal pregnancy with rupture; hematoma.

OPERATION

[Exposure of the pelvic viscera through a celiotomy-incision revealed the absence of the left tube and ovary and the presence of adhesions in their stead. On the right side of the pelvis a large, organized hematoma was found in relation with the right tube: the tube had ruptured and the hematoma had now become fairly well encapsulated, so that there was no free fluid in the peritoneal cavity—just sanguineous fluid. (This case again shows from the clinical course and the physical findings how one aids the other, when there is a discrepancy in the clinical course in arriving at a correct diagnosis.) The tube was dilated in its ampullary portion, while its fimbriated extremity was firmly adherent to the caput coli, which, together with the sigmoid flexure, covered over the hematoma. The fimbriated extremity of the tube was carefully freed from the caput coli, the mesosalpinx and uterine extremity were ligated, and the tube was removed; the ovary was permitted to remain; the sigmoid flexure was freed from the hematoma and the latter was removed. After taking stock of sponges and instruments, the celiotomy-incision was closed without drainage.]

POSTOPERATIVE COMMENTS

Owing to the firm adherence of the fimbriated extremity of the tube to the caput coli, it is not unlikely that a former attack of appendicitis was the underlying causative factor of this patient's state of ectopic gestation.

This patient should menstruate regularly and in practically the normal way. She should not suffer from the symptoms of her premature menopause, which might have given her enormous inconvenience had the remaining ovary been removed.

Postscript.—Progress of the case was uneventful.

CASE IV

CLINICAL HISTORY OF PATIENT

THE patient, twenty-five years of age, was admitted to Mercy Hospital February 19, 1916. The family and past histories are negative. Menstruation began when the patient was fifteen years of age, is of the thirty-day type, painless, lasts from four to six days, and requires three napkins a day. The patient has one child, who is living and well: there have been no miscarriages or abortions. Retroversion of the uterus was corrected by a pessary three and one-half years ago.

On January 1, 1916,—seven weeks ago,—the patient had the last normal menstrual period: the duration was five days.

On January 9th—four days after the termination of the normal menstrual period—she noticed a slight discharge of bright-red blood, soiling one napkin that day. The next day the quantity was unchanged, and continued so.

On January 19th, at 7.30 P. M., the patient was suddenly attacked by an *agonizing pain* throughout the abdomen: so severe was the pain that she fainted, and a hypodermic of morphin was required. She vomited that night and the next morning: fever and chills were absent. She remained in bed ten days, during which time the flow continued about the same: fever and chills were still absent. From January 29th to February 5th she was up and about, but felt very weak.

On February 5th, at 12 P. M., the patient had severe pains throughout the abdomen and in the lower part of the back, and chilly sensations two or three times, but no fever. This attack of pain, too, was so severe that a hypodermic of morphin was required. The next morning she vomited several times, and again on the following day: she did not, however, take to bed.

On February 9th a series of treatments to control the flowing was begun and continued until February 13th: at each treatment the vagina was sprayed with iodin and packed with gauze.

Since February 13th the patient has been up and about.

There has been neither morning sickness nor enlargement of the breasts, although the latter were slightly sensitive during her ten days' stay in bed after the attack which began on January 19th.

Examination on February 19th shows that the right vaginal fornix is perfectly free; that the uterus is soft and somewhat enlarged; and that there is a mass high up on the left side, behind the uterus: so tender is this mass that the patient winces when it is touched. The Abderhalden test is positive.

COMMENTS

Dr. Murphy (February 21, 1916): Is this a case of uterine or extra-uterine pregnancy? If the former, is there a pelvic tumor which is responsible for the flow? From all appearances the uterus is enlarged sufficiently to correspond with a normal pregnancy which had existed since December 1, 1915, yet packing of the vagina to check the flow did not bring on a miscarriage.

The mass on the left side carries the uterus up with it; and while it may not be a distended tube, yet the history is typical for ectopic gestation.

OPERATION

[Exposure of the pelvic viscera through a celiotomy incision revealed that the right tube and ovary both were free from adhesions and normal in appearance. The left tube had ruptured near the fimbriated end, and a large hematoma had formed, which was capsulated and firmly adherent to the sigmoid. In freeing the adherent sigmoid from the gestation-sac, a portion of the latter was, for safety's sake, separated and left attached to the former. The left tube was ligated and removed in the manner described in the preceding case (p. 516), but the ovary was retained. No raw peritoneal surfaces were left remaining, but were covered over. After taking stock of sponges and instruments, the celiotomy incision was closed without drainage.]

POSTOPERATIVE COMMENTS

In this case the hematoma has been of long standing. Given a case of acute perforative ectopic gestation: with the opened abdomen before you and blood welling up right briskly through the celiotomy-incision, how would you control the hemorrhage in the shortest possible time? Pass the hand rapidly behind the uterus and then along the broad ligament of the side involved; free the friable adhesions; roll the tube and ovary forward, and have an assistant place an eight-inch clamp on the broad ligament close to the uterus to control the uterine vessels, and another on the outer portion of the broad ligament, to control the ovarian vessels. Thereupon the clots may be removed and the operation terminated without undue haste. If the patient has lost much blood, intravenous infusion of normal saline solution may be given just as soon as you begin to go to work on the case. Drainage is not necessary unless you are fearful of your asepsis.

The patient is still capable of child-bearing, as the other tube is free from adhesions and patent.

Postscript.—The case progressed uneventfully.

(The "Abderhalden Test in Tubal Pregnancy" was considered in vol. iii, April, 1913, 206–10.)

The accompanying tables are taken from an unpublished paper of Dr. John B. Deaver, of Philadelphia:

TABLE I.—DIAGNOSIS MADE IN 162 CASES OF ECTOPIC GESTATION OPERATED UPON AT THE GERMAN HOSPITAL, PHILADELPHIA, IN A DECAD (DEAVER)

Ectopic pregnancy	96	cases
No diagnosis	29	"
Lacerated cervix	1	case
Chronic appendicitis	5	cases
Salpingitis	7	"
Cystic ovary	3	"
Acute appendicitis	5	"
Pyosalpinx	6	"
Carcinoma, uterus	2	"
Fibroid uterus	3	"
Abortion	1	case
Endometritis	4	cases

TABLE II.—THE OPERATIONS PERFORMED

Left salpingo-oöphorectomy	43	cases
Right salpingo-oöphorectomy	57	"
Double salpingo-oöphorectomy	16	"
Appendectomy	70	"
Hysterectomy	9	"
Left salpingectomy	17	"
Right salpingectomy	29	"
Double salpingectomy	2	"
Left oöphorectomy	4	"
Myomectomy	1	case
Marsupialization of sac	1	"

PYOSALPINGITIS, BILATERAL—CELIOTOMY; DRAINAGE

Summary: Clinical history of patient; operation—celiotomy followed by pelvic drainage for unsealed pus-tubes; comments—analysis of history; streptococcic peritonitis.

CLINICAL HISTORY OF PATIENT

The patient, twenty-two years of age, was admitted to Mercy Hospital May 25, 1915. The family and past histories are negative. Menstruation began at sixteen years, is regular, of the twenty-eight-day type, and lasts four or five days.

The patient has been married for three years: since the time of her marriage there has been leukorrhea, which at times causes much burning and scalding upon urination. One year after the marriage she had one miscarriage. A child was born nine months ago: the menses reappeared four months later and have been irregular, prolonged, and painful since. Owing to the dysmenorrhea the cervix was dilated, but the uterus was not curetted. The latest period has just been terminated.

On May 14, 1915,—eleven days ago,—the patient was suddenly awakened by a sharp, shooting pain in the right iliac region. She vomited once after taking a dose of castor oil. Soon the abdomen became tender and remained sore all day. There were no chills, but the next day chilly sensations were present. During the second day after the attack she stayed in bed, and in the evening was again attacked by abdominal colic, but did not vomit. The first attack began while the patient was menstruating: the flow continued for the next three days and then stopped. On the third and fourth days after the first attack she felt better, but the abdomen remained tender.

On May 18th the left iliac region became tender, and several times sharp pains appeared in that zone: these pains lasted two days, but were unaccompanied by vomiting. Menstruation began on the same day, lasted two days, and then stopped. The abdomen remained very tender.

On May 22d the patient flowed a little and the next day passed a few small clots, whereupon the flowing stopped. On the twenty-fifth there was a show of blood again.

Since May 14th, when the first attack of colic began, the abdomen has remained tender, and at times sharp, shooting pain appeared in the right iliac fossa. The bowels have been moving daily after the use of cathartics.

Examination of the blood on admission revealed 16,600 leukocytes. Urinalysis showed trace of albumin, but neither sugar nor casts: there were from 60 to 80 white cells to every $\frac{1}{6}$ objective microscope-field, but no red blood-cells.

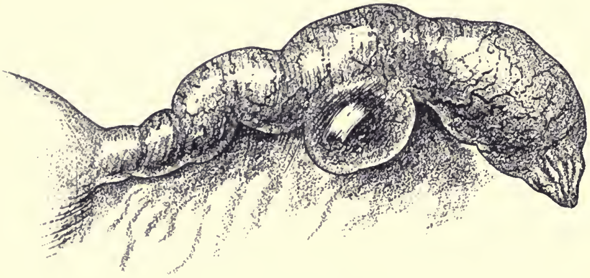

Fig. 105.—Pyosalpinx.

Bimanual pelvic examination revealed a mass of infiltration in Douglas's *culdesac*.

OPERATION

[The condition of the pelvic viscera was as follows: the uterus was surrounded by adhesions; both tubes contained pus (Fig. 105), which flowed from their fimbriated ends, showing that the latter were patent. Examination of the pus from these tubes showed that it was not a Neisserian infection, but that it was an acute involvement of the tubes in which as yet there had been no closure of the fimbriated ends. Pus from both tubes showed streptococci and B. coli. Owing to the patient's youth, as well as the patency of the fimbriated ends, the tubes were not removed, but drainage of the pelvis was provided for, and the celiotomy wound was closed. The operation was performed by Dr. Golden, and during its progress Dr. Murphy discussed the history with the intern as follows.]

COMMENTS

Dr. Murphy: I have not examined this patient because she was admitted last week during my absence from the city; but I shall try to build up a diagnosis from the history as recited by the intern. How old is the baby?

Intern: Nine months.

For how many months did she not menstruate?

For four months following the birth of the child.

Did she nurse the child?

She did not say.

You should have found out. Was that a normal flow on the fourteenth?

No, sir.

Let me check over the history until I show you all its defects. There is no record of the condition of the last menstrual period preceding May 14th. The patient menstruated May 1st and began to flow again on May 14th. Did she menstruate on April 1st?

Yes, sir, she did.

That was six weeks prior to May 14th. How many days did she flow, beginning May 1st? In order to exclude ectopic gestation we must know the date of the last normal menstruation preceding that. The menstrual period at which the patient became pregnant may deviate a little. At the next four-week period patients with ectopic gestation may flow a little, but it is never a normal menstruation: it is usually postponed to five, six, seven, or ten weeks. But the great bulk of ectopic gestations undergo rupture between the first days of the fifth week and the last days of the sixth, so that the date of the last normal menstrual period is always a definite starting-point in the diagnosis of this condition. Now it is evident why this patient should have a deviation in her menstruation if she nursed the baby, and why she should not have, if she did not nurse the baby. What began first, the flowing or the pain?

I have no record of that.

You ought to have it. When a tube is about to rupture, what should the patient have first? The pain. Did she have pain on the first day of May? Patients with an impregnated Fallopian tube always have stretching pains as the tube dilates, and because of these pains a large proportion of cases of ectopic gestation is diagnosed as gradually progressing acute appendicitis. What is the matter with the patient?

She may have appendicitis, pyosalpingitis, or ectopic gestation.

Which is it?

She has been complaining of a discharge for the last three years, and from the history of this previous infection I thought that she might have pyosalpingitis.

What was the nature of her previous infection?

Three years ago, after she was married, a yellowish vaginal discharge began and has continued to the present time: this discharge was accompanied by burning on urination.

What else? Did she have frequent urinations at the time she got the acute vaginal discharge and the acute irritation in the vagina?

She said she had increased frequency of urination at one time.

Did she get this infection then? Did the Neisserian infection travel up into the tubes at that time and set up pyosalpingitis? Does it state in the history that she had any other pain across the abdomen at that time?

No, sir.

Had she had an infection of the Neisserian type she should not have become pregnant. Was it acute salpingitis that made its appearance on May 14th, and was the accompanying pelvic peritonitis caused by a tubal infection? Was the infecting agent B. coli, pneumococcus, staphylococcus, or streptococcus? Two years ago last winter we had a number of cases of streptococcic infection of the lower abdomen, the primary source of which was the throat, the abdominal atrium, the appendix. I operated upon two of these cases, but in neither was the appendix perforated, for in this type of infection the streptococci run through the cellular tissue, just as water runs through a sieve. In practically all these cases streptococcic tonsillitis was the primary source of the metastatic peritonitis, and Dr. Miller, of this city, believed that the tonsillitis came from infected milk. Peritonitis is not commonly associated with tonsillitis or pharyngitis. The majority of these cases of streptococcic "peritonitis" die whether operated upon or not, for the infection is not on the surface of the peritoneum, but behind and beneath it (subperitoneal cellulitis), so that celiotomy has but little to offer.

[The remainder of the talk had to do with the subject of pelvic infections, for which consult vol. i, December, 1912, 807–824.]

Reporting a case and reviewing the literature on "Spontaneous Rupture of Pyosalpinx into the General Peritoneal Cavity, Producing Acute Diffuse Peritonitis," Bonney (*Surg., Gynec. and Obstet.*, November, 1909, 542–50) concludes as follows:

"1. It is a very rare accident [31 authentic cases up to 1909].

"2. In the severity of its symptoms it usually resembles other forms of perforative peritonitis.

"3. It conforms to the general rule obtaining in such cases, that the earlier operation is performed, the greater is the chance of recovery.

"4. It is a very momentous accident, having a mortality of 30 per cent., even in those cases in which operation is made during the first twelve hours.

"5. It should be considered as the possible causative agent in all cases of acute general peritonitis of obscure origin occurring in females.

"6. Its proper treatment is immediate operation."

Postscript.—Progress to recovery was slow but complete.

CASE I.—NEOPLASMS OF BOTH KIDNEYS; GASTRIC ULCER—EXPLORATORY CELIOTOMY. CASE II.—SARCOMA OF RIGHT KIDNEY—EXPLORATORY CELIOTOMY

Summary: Case I.—Clinical history of patient; comments—discussion by Dr. Mix; operation—gastric ulcer found at pylorus; neoplasm present in each kidney; organs not disturbed; postoperative comments—correlation of operative findings with history; nephrectomy: transperitoneal *vs.* lumbar; the phenolphthalein test; removal of a specimen and of either kidney contraindicated—reasons; danger of removing a kidney in direct proportion to its secreting power; postoperative treatment.

Case II.—Clinical history of patient; comments—examination and plan of operation; diagnosis of lesions of genitourinary tract by examination of urinary sediment; operation—neoplasm of right kidney found, but not disturbed; postoperative comments—neoplastic invasion of renal vessels.

CLINICAL HISTORY OF PATIENT

A MALE, forty-nine years of age, was admitted to Mercy Hospital October 15, 1915. The family history is negative.

The initial symptoms of the present malady occurred thirty years ago: ever since then similar attacks have manifested themselves every three or four months with no relation to the season of the year, and from four to six weeks in duration. Each attack is characterized by dull pain, coming on three hours after eating and lasting until the next meal, when food-relief is obtained: the pain is never present at night. The patient eructates a large quantity of gas, but is never nauseated and has never vomited during an attack. He is tender over the "stomach." The bowels are habitually constipated; the stools are never black.

The patient has lost 40 pounds in weight during the past eighteen months. He is very nervous.

The Wassermann test is negative. The urine is negative. A functional renal test shows only 45 out of a normal of 50.

COMMENTS

Dr. Murphy (October 21, 1915): There is a large mass in the right hypochondrium, quite apart from the liver: it must measure at least five inches in length, extends down beyond the costal margin, and moves with respiration; it invades the loin, where it may be distinctly palpated, thus from its position suggesting a renal tumor, such as congenital polycystic kidney or hypernephroma. It is lobulated, smooth in front, and as hard as wood.

The history is long and complex, and contains many points of interest. Strange to say, while many laboratory treatments have been given, no physical examination of his abdomen to determine the presence or absence of tumor was ever made until the patient came under our care. While he has a clinical history of duodenal ulcer extending over approximately a period of twenty years, the duration of the tumor is entirely unknown, as it was not recognized until the present time. Dr. Mix will discuss these interesting features with you.

Dr. Mix: The patient is a man who is endowed with a good deal of intelligence. Sometimes such an endowment works to the disadvantage of the examining physician, however, because the patient's memory of his symptoms is usually very good and his ability to expatiate upon them most excellent. The great danger is that such a patient will carefully and elaborately describe such a maze of symptoms that the examining physician is apt to be lost in a labyrinth in trying to arrive at a diagnosis. Unfortunately, notwithstanding their intelligence, such patients have not had a medical training, and, therefore, have a tendency to exaggerate things of no importance.

This patient told me that he had been bothered with his stomach for thirty or thirty-five years. For years he has been having periodic attacks lasting from four to six weeks at a time, and separated by latent periods of three or four months or even longer. Such periodic recurrences of gastric symptoms should always arouse the suspicion of the presence of a duodenal ulcer or of an ulcer in the pyloric zone of the stomach. Periodicity occurs in gall-bladder infections, but the periods of involvement are short, and the periods of remission in the early history rather long, but in the later history rather short. Where the patient makes no record of the matter of periodicity, the presumption from the symptoms is that he is more liable to be suffering from duodenal or pyloric ulcer than from a gall-bladder infection. The patient states that the season makes no difference in regard to his seizures. In other words, he has failed to notice the spring and fall exacerbations usually found in the history of the ordinary duodenal ulcer case.

The long duration of his history—namely, thirty or thirty-five years—is indicative of the presence of duodenal, rather than gastric ulcer. The usual history of gastric ulcer is that it runs a variable length of time,—anywhere from one to three or four years,—and that it even gets well for several years, subsequently breaking out again. On the other hand, duodenal ulcer may be more or less periodically active almost indefinitely, without a long intermission of several years.

The most important symptom of any case of ulcer is *pain or distress after eating.* This patient states that in the past the distress came on at a definite time after his meal—usually two or three hours, and that this pain lasted until he ate his next meal. Such a relationship between the pain and the time of occurrence is very characteristic of duodenal and pyloric ulcer, but is not characteristic of gastric ulcer. In gastric ulcer the pain comes on almost as soon as the food enters the stomach and stops when the food has left the stomach. In duodenal ulcer the patient feels at his best when food is in the stomach, but in gastric ulcer feels *worse* with food in the stomach. Another important point is that during the past he maintained his weight very well. It is true that during the last eighteen months he lost 40 pounds. Up to the last eighteen months his weight was practically constant. We shall account for his loss of weight subsequently.

The patient also complains of gas and of belching. Such complaints have little diagnostic value, because we meet with them in gastric ulcer, duodenal ulcer, chronic appendicitis, chronic cholecystitis, pericholecystitis, and periduodenitis. Since these symptoms of gas and belching have little or no diagnostic value, it is hardly worth while to pay any attention to them. They are almost invariably important in the patient's mind, and no doubt are very distressing, but their value as symptoms of diagnostic importance is minimal. Far more important is the fact that he has not suffered from nausea and vomiting. The classic symptomatology of duodenal ulcer does not show nausea or vomiting unless there should be involvement of the duodenal or of the regional peritoneum. It is only when duodenal ulcer attempts to perforate that it produces vomiting. On the other hand, vomiting in gastric ulcer is fairly common. It seems as though the ulcerous stomach is relieved by the escape of its contents and that, therefore, it exerts its efforts in order to free itself from the irritation.

In this case, also, it is a fair inference that no pyloric stenosis is present. If the patient had at the pylorus an ulcer which had undergone secondary cicatricial contraction, it would have so narrowed the pylorus that at the end of this long period of time there would have been a secondary dilatation of the stomach. By this time such a dilatation surely would have been associated with vomiting. The mere duration of the case and the absence of vomiting are practically proof-positive that there is no pyloric stenosis.

Two other symptoms of great import appear in his history: the first is constipation, which for years has been a favorite source of complaint on his part. In all cases of ulcer—whether gastric or duodenal—constipation is extremely frequent. On the other hand, in gall-bladder infection constipation is not a symptom; it, therefore, has frequently a very great differential value. In this case we believe it indicates the presence of duodenal or pyloric ulcer, rather than any gall-bladder infection.

The other characteristic symptom which this patient does not show is hemorrhage. About 20 per cent. of ulcers of the duodenum is associated with hemorrhage at some time or another. So far as he knows this patient never had a black or tarry stool, never passed any blood, either red or decomposed, and never vomited any blood. We are, therefore, forced to make our diagnosis without the support of either emesis of red blood or passage of melena.

In this briefly summarized history no mention was made of the patient's neurasthenic state. Out of the wealth of details which he recounted there can be discerned a large group of neurasthenic symptoms: in fact, he has been called a "neurasthenic" for thirty or thirty-five years. He has gone from one physician to another, and from one sanitarium to another, and evidently has been hailed everywhere as a "neurasthenic." Indeed, his story alone certainly arouses the presumption of such a diagnosis. Among other things, he has followed in the footsteps of many neurasthenics in going to one of the eastern prize-fighting camps, where he spent a summer two or three years ago to his great advantage. While there he says he gained several pounds in weight and came away practically cured. Such a recital would lead almost any one to believe that an individual of this type had all his troubles in his head, and yet such a belief would be erroneous. The fact is, that vast numbers of cases have in the past been labeled "gastric neuroses" when they should have been labeled duodenal ulcer. Whenever you are tempted to make a diagnosis of "gastric neurasthenia" stop and ask yourself whether the patient is suffering from duodenal ulcer. There is no organic disease of the abdomen which resembles "neurasthenia" so closely as duodenal ulcer. The duodenal ulcer patient is always complaining. He is always belching gas, always has pain, and always taking bicarbonate of soda; he is always trying first this kind of food and then that kind; he is always constipated, and yet manages to maintain a fairly constant weight. The reason for his good weight is based on the fact that he feels better when food is in his stomach, so that he is tempted to eat; but this very good weight is the thing which, in the minds of those not instructed in the symptomatology of duodenal ulcer, raises a strong belief that the patient is a "neurasthenic." Therefore, in presenting the symptomatology of duodenal ulcer very strong emphasis should be placed upon the neurasthenic state of the patient.

There is still a very important negative element in this patient's history, that is, the *lack of evidence of constitutional infec-*

tion. There is no complaint of joint disturbances, "muscular rheumatism," headache, fever, or chills. There is no evidence that he ever had an infection in the gall-bladder, appendix, prostate, urinary bladder, urethra, or kidneys. These negative findings as to infection are extremely important. No case of chronic cholecystitis or gall-bladder infection exists which does not show at some period in its course the well-known footprints of infection. In this patient's history you will find throughout no trace of constitutional infection. Taking into consideration his history and the absence of specific signs of infection, the diagnosis of duodenal ulcer seems to be correct.

Inasmuch as the patient exhibits neurasthenic stigmata; inasmuch as he has been a victim of gastric disturbances for a period of thirty or thirty-five years; inasmuch as his periods of exacerbation have been of from four to six weeks' duration—separated by intermissions of three or four months; inasmuch as he has had pain coming late after meals, lasting until the next meal and relieved by the ingestion of food; and inasmuch as he is very constipated and has shown no nausea, no vomiting, nor any signs of infection—upon these grounds we feel justified in making a diagnosis of ancient duodenal ulcer. The ulcer may be close to the pylorus, but from the symptomatology one would be justified in saying that it is not close to the pylorus, but a short distance from it. In this connection a general diagnostic rule may be stated, namely, the farther the ulcer is from the pylorus, the later is the onset of pain and the more prominent the symptom of food-relief.

Finally, there are the laboratory findings to consider. Examination of the Ewald test-meal showed merely the presence of hyperchlorhydria. Such hyperchlorhydria is characteristic of duodenal or gastric ulcer, but it is not imperative that hyperchlorhydria should exist if the diagnosis is to be made. Very many cases of ulcer are encountered where hyperchlorhydria has not been present. There was also absence of blood in the feces and stomach-contents: this means nothing. It is by no means probable that we are examining the patient at a time when his ulcer is very active. At the present time, from absence of blood in the feces, it is altogether probable that the ulcer is healed over.

At this juncture we are able to take up an entirely new set of findings and symptoms. For the last eighteen months the patient has been steadily losing weight: in all, 40 pounds. During the eighteen months he has consulted several physicians, but, curiously enough, none took the trouble to examine his abdomen until he consulted Dr. Murphy. The presumption is that the "neurasthenic" story was related and listened to, but not heeded. On examining his abdomen we found a very large tumor situated beneath the right costal margin and moving up and down with respiration as though it were a part of the liver. It extends downward almost to the iliac crest. It has no sharp edge such as it would have were it an enlarged liver; it is not possible to get the finger hooked under it from below, nor to insert the finger between the upper margin of the tumor and the costal margin and liver. From these facts alone it is quite certain that the tumor is not formed by an enlarged right lobe of the liver or an hepatic abscess.

For the last few months the patient has been complaining of pain in the right iliac and right lumbar regions. It was noted that the pain is referred both anteriorly and posteriorly. The tumor can be felt well around in the side of the lumbar region: furthermore, its lower edge seems to be somewhat lobulated and round. A tumor in this locality, which is movable with respiration, distinct from the liver, situated below it, and which extends into the right side, raises the presumption that it involves the kidney by some process, malignant or cystic.

It cannot be a tumor of the stomach because it lies too far to the right and too low down, unless it has been displaced by a dilated stomach full of retained fluid. The only tumor of the stomach which it could possibly be is carcinoma of the pylorus; but pyloric cancer the size of this tumor would have produced such a high degree of obstruction that by this time there would have been secondary dilatation and a great deal of vomiting. The tumor cannot be a retroperitoneal tumor of any variety, because it is not fixed to the posterior abdominal wall, but moves readily with respiration, just as the kidney does.

There are two or three things which the tumor might be—cystic kidney, sarcoma, or hypernephroma. Hypernephromata are distinguished by their comparatively large size and liability to form metastases, but particularly by the tendency of these metastases to involve bones. They are further characterized most notably by the presence of blood in the urine. There are, however, numerous exceptions to all these symptoms. Hypernephromata frequently exist without causing hematuria. Furthermore, they are sometimes only semimalignant, that is, lasting four or five years without causing metastases, so that, so far as the symptomatology and physical findings in this case are concerned, the diagnosis of hypernephroma is apt to be just about as accurate as that of any other form of kidney lesion.

Unfortunately, it was not possible to catheterize the ureters: therefore, we are unable to say previous to operation whether the right kidney is putting out very much urine and whether the left kidney is performing its function thoroughly. The Wassermann test was negative, so that there hardly seems to be a syphilitic element.

Sarcomata of the kidney are unusual at the time of life which this patient has reached, but occur more frequently in children under five years of age, Congenital polycystic disease usually manifests itself long before his time of life, so that this is not a very likely diagnosis. The most plausible diagnosis is hypernephroma of the right kidney, though conjectural because we cannot back it up by hematuria or by metastases. The character of the tumor must be settled by operation, and perhaps even subsequent to that: possibly the microscope alone will be able to reveal the nature of the tumor.

We shall, therefore, conclude with the diagnoses of duodenal ulcer and neoplasm of the right kidney, and incline to the opinion that the latter will prove to be a hypernephroma.

OPERATION

[Through a celiotomy-incision exploration of the upper abdomen was begun. The liver was found to be normal. The pyloric zone of the stomach showed the typical white scar of an ulcer which, upon palpation, proved to be firm and deeply excavated, and therefore possibly malignant: it did not occlude the pylorus. The mass, which was palpated in the loin at the time of the physical examination, proved to be a lobulated, semisolid, non-adherent tumor of the right kidney, which was probably malignant in nature. The left kidney showed at its upper pole —in the adrenal zone—a firm, hard (wood-like) tumor the size of an English walnut: this kidney itself was small—not over one-third of the normal size. No further operative measures were taken,—the organs were not disturbed,—and, after accounting for sponges and instruments, the celiotomy-incision was closed in the usual manner without drainage.]

POSTOPERATIVE COMMENTS

The history, which was typical for gastric or duodenal ulcer, was cleared up by finding the ulcer in the pyloric zone of the stomach: owing to the involvement of both kidneys by probably malignant neoplasms, we deemed gastrojejunostomy inadvisable.

The findings on physical examination were corroborated by the presence of the neoplasm involving the right kidney: this organ was of such a size that while it could have been removed by the transperitoneal route very easily by merely pushing the colon inward and dividing the posterior parietal peritoneum along the outer, convex border of the kidney, yet to have removed it by the lumbar route would have been a very difficult task. Having determined that the right kidney was involved by a neoplasm we followed the rule to be observed in this class of cases by immediately palpating the left kidney.

One of the dangers of lumbar nephrectomy is the admission of urine into the field during the course of the operation. By the anterior (transperitoneal) method, however, such leakage may be avoided after exposure, ligation, and division of the vessels, by isolating the ureter, clamping it between two forceps and dividing it: then the kidney may be readily rolled out from behind forward. By this anterior route, too, any aberrant renal arteries—of which there may be one or two passing more commonly to the lower pole—can be not only easily detected, but also just as easily dealt with. Furthermore, in operating on the right side the duodenum can be easily protected. Accidents to the duodenum with large right-sided renal tumors are not uncommon and are always extremely serious.

The functional renal test by the phenolphthalein method showed that the combined output of both kidneys was practically normal; but since we were unable to catheterize the ureters, we were equally unable to determine what proportion of the output each kidney of itself was contributing.

A tissue-specimen was not removed from either kidney for fear of disseminating the suspected malignant neoplasm, which was well encapsulated: let sleeping dogs lie. I dared not remove either kidney because both were involved by neoplasms; and even if the right kidney had been the seat of polycystic disease alone, I dared not remove it because of the aplasic condition and small size of the left kidney,—aside from the presence of the neoplasm in the latter organ,—and the concomitant danger of suddenly burdening it with an overwhelming amount of work.

The danger of removing a kidney is in direct proportion to its secreting power: thus, the removal of a practically normal kidney at once throws a colossal load upon the remaining kidney, and the operative mortality of such a procedure is about 30 per cent.; only a 2 per cent. mortality, on the other hand, follows the removal of a kidney which has undergone cystic or infection-degeneration to such an extent that it is functioning but 2, 5, or 7 per cent. of the normal; while the removal of a renal pus-sac—one, for example, which is as large as one's hat, and therefore has no functioning parenchyma left remaining—carries with it practically no danger at all.

There is great danger in removing a kidney which is so slightly involved by disease that it retains nine-tenths of its normal secreting power,—such, for example, as one which contains a small cyst, small sarcoma, or small abscess,—for here again, just as in the removal of a normal kidney, the load is *suddenly* thrust upon the remaining kidney.

It was these considerations which many years ago led Morris to drain all suppurative renal cases for weeks or months before extirpating the diseased kidney, so that the work performed by the remaining functioning parenchyma could be *gradually* transferred to the opposite kidney: Morris's adoption of this plan very markedly lowered the mortality of nephrectomy in his own hands.

The patient will be given therapeutic doses of *x*-rays and hypodermic injections of sodium cacodylate.

Postscript (*February 16, 1916*).—It is now four months since the exploratory celiotomy was performed and medication instituted. The enlargement in the right loin, which was due to the renal neoplasm, has become very materially diminished both in front and behind—especially behind. The patient's weight remains about the same.

The discomfort following eating still continues, but is kept under fair control by the use of bismuth, soda, and magnesia. The *x*-ray and sodium cacodylate treatments are to be maintained.

CASE II

CLINICAL HISTORY OF PATIENT

A FEMALE, fifty years of age, was admitted to Mercy Hospital October 19, 1915. The family and past histories are negative. The catamenia occurred two months ago.

On May 20, 1915, while sitting down, the patient suddenly experienced an uncomfortable sensation passing down from head to foot, and immediately afterward felt nauseated, but did not vomit: the sensation lasted for about five minutes. There were no other symptoms.

On May 30th pains of moderate severity and not unlike labor-pains appeared in the abdomen and lasted twenty-four hours, giving way to a dragging discomfort throughout the entire right side of the abdomen.

During the past month the patient has been nauseated and vomited daily—as often as two or three times a day; her appetite is gone, and within the past four months she has lost 50 pounds in weight. She has not been confined to bed, and was able to perform housework up to within the last fortnight; since that time, however, she has felt very weak.

The following symptoms or signs are absent: fever, chills, headache, constipation, urinary disturbances, metrorrhagia, tenderness. Since four months there has been no actual pain, but merely dragging discomfort in the right loin.

Cystoscopic examination revealed no edema or congestion about the orifice of the right ureter. From the left ureteral orifice urine appears at normal intervals. The phenolphthalein test showed during the first hour, 0; second hour, 18; third hour, 17: total, 35—subnormal!

COMMENTS

Dr. Murphy (October 20, 1915): There is a tumor in the right loin with these characters: its lower margin extends across the abdomen as far as the navel and presents a notch similar to that on the lower border of the liver; the left margin permits the hand to pass beneath it clearly and definitely: it is round and hard; the right margin is also round and hard, and presents a definite notch; on displacing the mass downward no apparent flatness appears in the midline: there is no hepatic flatness.

The left kidney is distinctly palpable and two-thirds larger than normal: it is not continuous with the mass on the right side and therefore is not a horseshoe kidney.

Pelvic examination is negative.

When I operate I shall examine the left kidney first, in order to determine the presence of metastases or a concomitant neoplasm; and if, when examining the tumor on the right side, I should conclude that it is a small round-cell sarcoma, but not a hypernephroma, I will not perform nephrectomy, for statistics have shown that operation does not benefit this condition, and that patients live just as long without the small round-cell sarcoma being disturbed.

The clinical history is against the lesion being a renal tumor because there has been no blood in the urine at any time. We dislike very much to schedule a case upon the board as one for exploratory celiotomy, but in this case neither Dr. Mix nor myself could arrive at a diagnostic conclusion.

Upon catheterizing the ureters yesterday it was found that

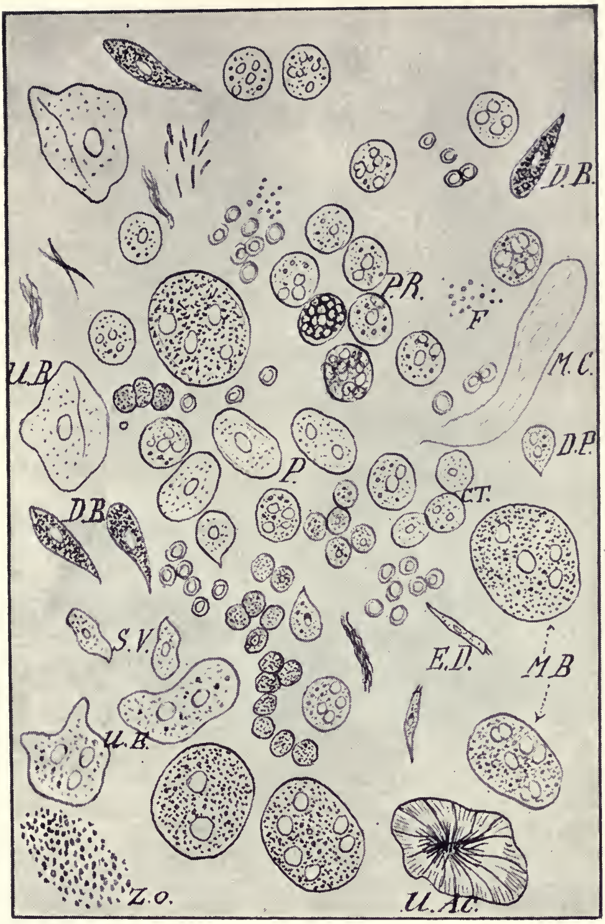

Fig. 106.—Microscopic findings in Case III. Examination of urinary sediment revealed: Red blood-corpuscles—moderately numerous; pus-corpuscles—abundant, fairly granular, some containing fat.

Epithelia from *P.R.*, prostate—abundant, some containing fat and many endogenous new formations; *D.P.*, ducts of prostate—numerous, some containing fat; *S.V.*, seminal vesicles—few; *E.D.*, ejaculatory duct—few; middle bladder—numerous, some containing fat and endogenous new formations; upper bladder—numerous; deep bladder—moderately numerous, some containing fat; *U.E.*, urethra—moderately numerous; convoluted tubules—few; pelvis of ureter—few; connective-tissue shreds—few; *M.C.*, mucus—abundant; *Z.O.*, zoöglea—numerous; *F.*, free fat—considerable; bacteria—abundant; uric acid needles and concretions—numerous.

Diagnosis made from urinary sediment and confirmed at operation. "Chronic prostatitis, seminal vesiculitis, and cystitis, due to hypertrophy of prostate. Stone: uric acid present, probably in bladder. Mild pyelonephritis." (G. A. Wyeth, N. Y. Med. Jour., Sept. 2, 1911, Fig. 5.)

the flow of urine from the right kidney was diminished in amount: a piece of tissue brought out in the eye of the catheter was examined and diagnosed by the pathologist as round-cell sarcoma.

G. A. Wyeth, of New York, in a very able paper, points out the possibilities of determining the location of pathologic lesions of the genitourinary tract from study of epithelia found in urine (Figs. 106–108). The investigations were carried out in Israel's clinic, in Berlin, and were based upon the method previously described by Heitzmann. Wyeth concludes in part as follows:

"The cases herein described have been selected as best illustrating the results which can be obtained from careful microscopic urinalysis, *since the diagnoses were corroborated by operation;* and others could be cited in which a doubtful clinical diagnosis was entirely cleared up by the microscopic findings in the urine. Such cases prove beyond doubt that, through the differentiation of the various epithelia in the urine, we have a reliable means of locating lesions in the genitourinary tract, regardless of whether the pathologic condition can be diagnosticated or not."

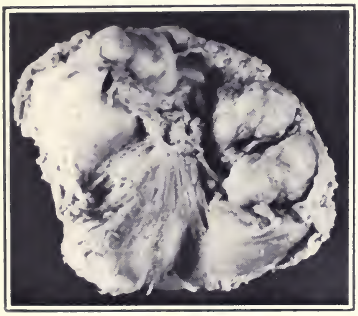

Fig. 107.—Hypertrophy of prostate; diagnosis made from urinary sediment. (See Case III.) Both lateral lobes as large as plums. Middle lobe cherry size. Stone size of cherry seed (G. A. Wyeth).

In many of these cases no aid is obtained through cellular findings in the urine, as we have shown by careful examinations for years. When they are found they may be of diagnostic value, but they have no negative value.

OPERATION

[Through a celiotomy incision there was revealed a neoplasm involving the right kidney, with small metastatic daughter-tumors proceeding upward along the vena cava as well as a larger mass spreading over the diaphragm. The lesion being inoperable, the incision was closed forthwith.]

POSTOPERATIVE COMMENTS

The pathologist's preoperative diagnosis of sarcoma of the kidney was correct: I must say that it did not seem possible to base an accurate diagnosis upon such a small matter as a piece of tissue that came out in the eye of the catheter. It is strange

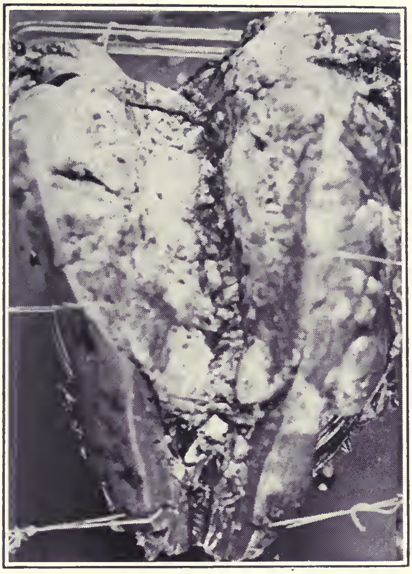

Fig. 108.—Tumor of kidney; diagnosticated from urinary sediment. (See Case IV.) Description of preparation taken directly from hospital records: Kidney, 15 cm. long, 10 cm. broad, 6 cm. thick. Outside kidney nodular, especially at upper pole. These nodules evidently represent tumor nodules, and are partly yellow and yellowish red, and partly hemorrhagic in color. In hilus the vena renalis is enormously thickened, 3 to 4 cm. in diameter, filled with light yellow tumor thrombus. On transverse section the upper third is filled with tumor masses, the lowest of these pressing against the wall of kidney pelvis, narrowing same, but not perforating the wall. The tumor nodules show mostly a yellow or red striated color. In the center they are fibrous, cicatricial, and show cellular degeneration. The lower two thirds of cortex and medulla are markedly swollen, moist—details of structure indistinct—and infiltrated by many small abscesses. The mucosa of pelvis succulent and transparent.

Autopsy revealed a nodule in prostate the size of small marble which was diagnosticated by the pathologist as adenocarcinoma. (G. A. Wyeth, N. Y. Med. Jour., Sept. 2, 1911, Fig. 7.)

that hematuria—which is one of the common continued signs of both hypernephroma and sarcoma of the kidney—was in this case always absent.

The tumor was of rapid growth. Such a sarcoma is liable to invade the renal vessels: when this state of affairs is present, the removal of the kidney by the lumbar route is particularly hazardous, owing to the unavoidable tug during delivery upon vessels already weakened by neoplastic invasion. (The advantages of the anterior or transperitoneal method have been pointed out in the preceding case.)

(For comments upon sarcoma of kidney, ovary, and testis, together with bibliography, consult vol. iv, October, 1915, 921–2.)

The patient will be given the usual palliative treatment for sarcoma—Coley's serum, arsenic, and *x*-rays (*vide* vol. iv, October, 1915, 951–5).

Postscript.—The patient's convalescence was uninterrupted. We have had no information from her since she returned to her home.

VESICAL CALCULUS (TWO CASES)—SUPRAPUBIC LITHOTOMY

Summary: Case I.—Clinical history of patient; comments—variation in the symptom of pain; comparison between frequency of urination in calculus and in prostatic hypertrophy; question of concomitant removal of prostate; synopsis of vesical calculus; methods of detecting stone in bladder; operation—suprapubic lithotomy; postoperative comments—pneumonia as a postoperative complication.

Case II.—Clinical history of patient; comments—importance of early detection and removal of calculus; litholapaxy *vs.* lithotomy; operation—suprapubic lithotomy.

CLINICAL HISTORY OF PATIENT

A MALE, seventy-four years of age, was admitted to Mercy Hospital February 13, 1916. The family and past histories are negative.

In the fall of 1909 the patient noticed that he had to urinate about every hour and a half during the daytime: the urine did not flow at once, but was delayed about fifteen seconds; after the bladder was emptied the flow stopped short, and did not dribble. There was neither dysuria nor hematuria, and the urine appeared normal. During the night the patient urinated three times, and just as often during the day. In the spring of 1910—when the weather was warmer—he had to urinate only every three hours, and during the night but once or twice. At this time the urine was apparently normal. The act of micturition was the same as before, but the patient thought that the stream flowed somewhat more slowly than usual.

In the winter of 1911 urination increased in frequency, and there was difficulty in starting the flow.

In the summer of 1911 the frequency decreased, but the stream flowed with less force.

In the spring of 1912 the patient noticed that the urine was red in color: the next day it was darker; the day after that, lighter; and on the fourth day the unusual dark color disappeared. There was no dysuria.

In the fall of 1912 urination again increased in frequency, and dysuria appeared for the first time: the pain was mild in character, and was present when the patient forced the urine to flow; when the stream started, the pain disappeared.

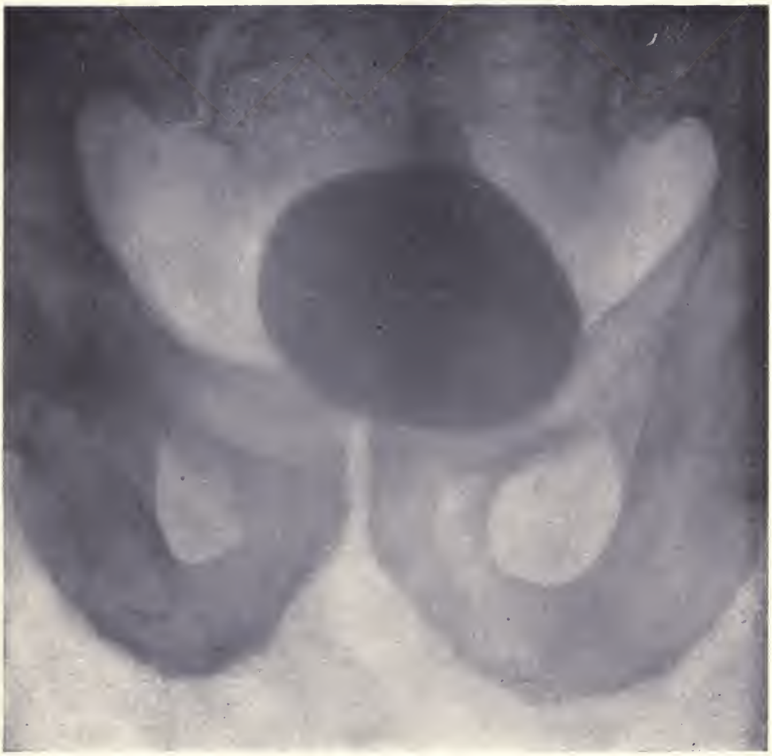

Fig. 109.—Colossal stone in bladder.

From the fall of 1912 to December 20, 1915, urination gradually increased in frequency, and the pain somewhat in severity.

On December 20, 1915, while the patient was ill with influenza, he noticed that the urine did not flow as rapidly as it should, and that it was very cloudy. A physician passed a catheter and two days later a sound, and stated that no stone was present, but that the prostate gland was enlarged and ought to be removed. The case was referred to me as one of enlarged prostate gland, but the clinical course of the case did not correspond with that diagnosis.

Rectal examination revealed mild enlargement of the prostate, but no nodules suggestive of malignancy were palpated. Skiagram revealed a stone the size of a goose's egg in the bladder (Fig. 109), notwithstanding none was detected when the patient was sounded by his attending physician some weeks previously.

COMMENTS

DR. MURPHY (February 14, 1916): The history of the patient's malady extends over the course of the last seven years. A symptom which is at variance with the usual finding in cases of vesical calculus is the time of appearance of the pain: in his case the pain *precedes* urination, occurring during his effort to get the flow started; there is little or no pain after the bladder has emptied itself. This symptom is misleading, and there is a definite reason why it is at variance with the time of onset of pain in the usual case of vesical calculus—the bladder contains a smooth stone the size of a goose's egg, against which it cannot contract with enough force to traumatize the sensitive trigone, upon which the usual small stone is stranded in the ordinary case.

In most cases of vesical calculus the frequency of urination is increased in the daytime and diminished at night—just the reverse of prostatic hypertrophy, in which there is increased frequency at night, but little or no increase during the day.

The prostate gland is not unduly enlarged: the question arises whether or not we should remove the prostate when we remove the stone; prostatectomy in a patient seventy-four years of age is an operation of considerable magnitude. It is my intention, therefore, not to remove the gland unless the intravesical examination shows it to be seriously enlarged: it is much better surgical judgment to free him from the irritation of the stone at the present time and postpone the removal of the prostate, than to perform both operations at one sitting. The number of operations is an insignificant matter when the patient's safety is enhanced thereby.

Cabot's statistics of lithotomy, as shown in the table, seem unduly high as regards mortality, especially when the mortality of the severer operation—prostatectomy—is but 4 per cent., approximately.

SYNOPSIS OF STONE IN URINARY BLADDER

Physical and Chemical Characteristics

1. Uric acid.
2. Oxalic acid.
3. Phosphoric acid.
    - Albuminoid nucleus.
    - Law of crystallization (Rainey).
    - Molecular coalescence (concentric).
    - Conformation—facets.

Etiology:
- Constitutional.
- Local.

Symptoms:
- Sudden stoppage of stream.
- Pain—time, etc.; effect of residual urine.
- Reflex pain.
- Hematuria.
- Sounding; details; causes of error.
- Cystoscope.
- Skiagram.

Treatment and mortality:

	Suprapubic Lithotomy	Litholapaxy	Lateral Lithotomy
Children under 14...	10 per cent.	1.66 per cent.	55 per cent.
Adults 22 to 50.....	12 " "	3.25 " "	17 " "
Old men...........	15 to 20 " "	6 " "	26 " "

(*Cabot.*)

Complications: Enlarged prostate; infection; foreign body; cancer.

Recurrence: Recurrence of vesical calculi, like recurrence of renal calculi, is much commoner than is generally believed.

Fistulæ.

In establishing the diagnosis of stone in the bladder we no longer employ the sound or the catheter, lest urethral fever should by some chance arise: the substitute for the time-honored stone-sound is the *x*-ray; while in children a stone may frequently be detected by bimanual palpation.

OPERATION

[A sound was introduced into the bladder and struck the stone with an audible click. A suprapubic incision was made through the linea alba, and the pubic heads of the recti muscles were detached and reflected outward. A finger introduced into the space of Retzius palpated the sound through the bladder-wall. The peritoneum was reflected upward, unopened. Two anchor sutures were inserted into the bladder, and the organ was opened between them, the scalpel coming directly down upon the sound. After the urine had flowed out the cavity of the bladder was inspected and a stone detected which measured 3 by 2¼ inches (Fig. 109). The stone was broken and taken out in fragments, thus rendering a large bladder incision unnecessary. Inspection of the mucosa revealed chronic cystitis with *brie*, but no frank infection. The middle lobe of the prostate gland was not enlarged, and there was no evidence of prostatic obstruction or of carcinoma of the prostate or bladder. After accounting for sponges and instruments the incision in the bladder was closed by passing sutures down to the mucosa, but not through it. The anchor stitches were removed, and a drainage-tube was inserted into the bladder. The heads of the recti were restored to the pubic bones, and the laparotomy incision was closed in the usual manner, room for the drainage-outlet being provided for.]

POSTOPERATIVE COMMENTS

In operating upon a patient of such advanced age at this season of the year there is danger of postoperative pneumonia: this winter, however, has been an exceptionally mild one, so that better hospital ventilation prevailed, and we did not have a single serious case of pneumonia up to date, nor a single death from that disease, so far as I know, which is a very unusual state of affairs.

Postscript (*March 6, 1916*).—It is now three weeks since the operation was performed. On March 2d the patient began passing urine *per urethram*, and has so passed some of it daily since. He is in good condition and gets about in an invalid's chair.

CASE II

CLINICAL HISTORY OF PATIENT

A male, ten years of age, was admitted to Mercy Hospital April 7, 1915. The family and past histories are negative.

In June, 1913,—nearly two years ago,—the patient noticed for the first time an aching discomfort just above the pubes, and increase in the frequency of micturition—six or eight times during the day and two or three times at night. As time went on both these symptoms became aggravated—the aching discomfort more constant, and the frequency more marked.

At present micturition takes place about thirty times a day and ten at night, the quantity voided each time being about two fluidounces: each act is followed by burning discomfort, and often by a sharp pain, which is referred along the urethra to the bladder. At times, according to the boy's statement, a small quantity of blood and pus is passed. There was no definite history of sudden stoppage of urine.

The patient has lost no weight; his appetite is good. There is no history of vomiting. The bowels move daily.

Skiagram at our office reveals a stone in the bladder.

COMMENTS

Dr. Murphy (April 10, 1915): It is hard to believe that, with such a cleancut history which is typical for stone in the bladder, this patient was neglected for nearly two years and treated merely for "enuresis." Because of the chronicity of the lesion and the constant irritation by the stone the bladder has become congested and infected, as shown by the presence of pus in the urine and sometimes blood, and it may continue in a state of irritability for several years after operation. By employing modern methods of examination there is but little excuse for overlooking a vesical calculus,—even in children,—for, if a stone cannot be felt by the sound and by bimanual palpation, it will certainly be revealed by a skiagram: in the young child the bladder is practically an abdominal organ, thus facilitating detection of a stone by the former method, while a stone in the young bladder is clearly revealed in the skiagram.

Shall we remove the stone by litholapaxy or lithotomy? A certain degree of risk attends the prolonged manipulations which are necessary in the crushing operation: we therefore prefer lithotomy, and advocate the suprapubic route. Until recent years lateral perineal lithotomy was the method of choice, but now we believe that approach to the bladder by this route entails an undue amount of unnecessary trauma, both to the perineal structures and to the important vesical sphincter. The suprapubic method, on the other hand, does not injure the bladder at a vulnerable point.

OPERATION

[By the same technic employed in the preceding case a single, smooth, non-faceted calculus was exposed, loosened from the mucosa in which it was imbedded, and removed. The bladder was carefully inspected to see that no additional calculi remained, and then closed as in the preceding case.]

Postscript.—There was rapid closure of the fistula, and the case progressed to recovery uneventfully.

[*N. B.* In conjunction with the abdominal cases published in this number the reader is referred to the report of 71 selected interesting cases,—mostly abdominal,—together with copious statistics, from the clinic of Dr. John B. Deaver at the German Hospital, Philadelphia (*International Clinics*, vol. iii, 23d series, 158–248).]

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